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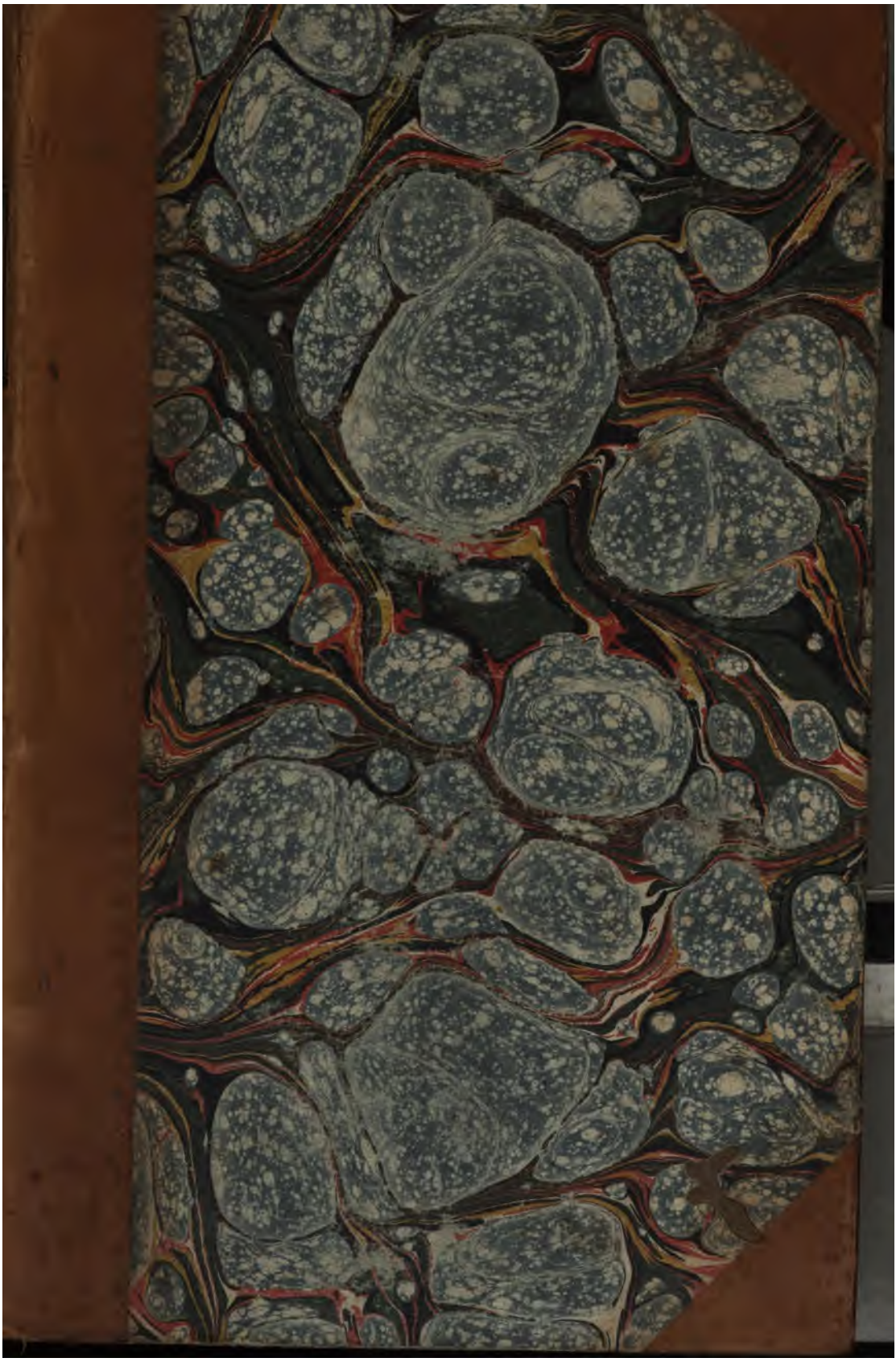

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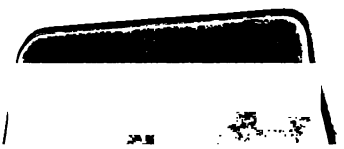

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THE

TECHNICAL REPOSITORY;

CONTAINING

Practical Information

ON SUBJECTS CONNECTED WITH

DISCOVERIES AND IMPROVEMENTS

IN THE

USEFUL ARTS.

ILLUSTRATED BY NUMEROUS ENGRAVINGS.

BY THOMAS GILL,

A CHAIRMAN OF THE COMMITTEE OF MECHANICS
IN THE SOCIETY FOR THE ENCOURAGEMENT OF ARTS, MANUFACTURES,
AND COMMERCE, ADELPHI,
AND HONORARY MEMBER OF THE ROYAL PRUSSIAN ECONOMICAL
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THE

TECHNICAL REPOSITORY.

I.—*On the Gold Mines of North Carolina, and on the method of extracting the Gold. By* DENISON OLMSTED, *Professor of Chemistry and Mineralogy in the University of North Carolina*.*

THE gold mines of North Carolina, which have recently become an object of much inquiry, both at home and abroad, are situated between the 35th and 36th degrees of N. latitude, and between the 80th and 81st degrees of W. longitude from London. They are on the southern side of the State, not far from the borders of South Carolina, and somewhat westward of the centre. Through the gold country flows the river Pedee, receiving within the same district the Uwharre, from the north, and Rocky River from the south, both considerable streams. Above the junction with the Uwharre, the Pedee bears the name of Yadkin.

The gold country is spread over a space of not less than 1000 square miles. With a map of N. Carolina one may easily trace its boundaries, so far as they have been hitherto observed. From a point taken eight miles west by south of the mouth of the Uwharee, with a radius of eighteen miles, describe a circle,—it will include the greatest part of the county of Montgomery, the northern part of Anson, the north-eastern corner of Mulenburg, Cabarrus, a little beyond Concord on the west, and a corner of Rowan and of Randolph. In almost any part of this region, gold may be found in greater or less abundance, at or near the surface of the ground. Its true bed, however, is a thin stratum of gravel inclosed in a

* From the American Journal of Science and Arts: vol. ix.

dense mud, usually of a pale blue, but sometimes of a yellow colour. On ground that is elevated and exposed to be washed by rains, this stratum frequently appears at the surface; and in low grounds, where the alluvial earth has been accumulated by the same agent, it is found to the depth of eight feet: where no cause operates to alter its original depth, it lies about three feet below the surface. Rocky River and its small tributaries which cut through this stratum, have hitherto proved the most fruitful localities of the precious metal.

The prevailing rock in the gold country is argillite. This belongs to an extensive formation of the same, which crosses the State in numerous beds, forming a zone more than twenty miles in width, and embracing, among many less important varieties of slate, several extensive beds of novaculite, or whetstone slate, and also beds of petrosiliceous porphyry and of greenstone. These last lie over the argillite, either in detached blocks, or in strata that are inclined at a lower angle than that. This ample field of slate I had supposed to be the peculiar repository of the gold; but a personal examination discovered that the precious metal, embosomed in the same peculiar stratum of mud and gravel, extends beyond the slate on the west, spreading, in the vicinity of Concord, over a region of granite and gneiss.

A geographical description of the gold country would present little that is interesting. The soil is generally barren, and the inhabitants are mostly poor and ignorant. The traveller passes the day without meeting with a single striking or beautiful object, either of nature or of art, to vary the tiresome monotony of forests and sandhills, and ridges of gravelly quartz. Here and there a log hut, or cabin, surrounded by a few acres of corn and cotton, marks the little improvement which has been made by man, in a region singularly endowed by nature. The road is generally conducted along the ridges, which slope on either hand into valleys of moderate depth, consisting

chiefly of fragments of quartz, either strewed coarsely over the ground, or so comminuted as to form gravel; these ridges have an appearance of great natural sterility, which, moreover, is greatly aggravated by the ruinous practice of frequently burning over the forests, so as to consume all the leaves and under-growth, giving to the forest the aspect of an artificial grove.

The principal mines are three—the Anson mine, Reed's mine, and Parker's mine.

The Anson mine is situated in the county of the same name, on the waters of Richardson's creek, a branch of Rocky River. This locality was discovered only two years since by a "gold hunter,"—one of an order of people that begin already to be accounted a distinct race. A rivulet winds from north to south between two gently sloping hills that emerge towards the south. The bed of the stream, entirely covered with gravel, is left almost naked during the dry season, which period is usually selected by the miners for their operations. On digging from three to six feet into this bed, the workman comes to that peculiar stratum of gravel and tenacious blue clay, which is at once recognised as the repository of the gold. The stream itself usually gives the first indication of the richness of the bed through which it passes, by disclosing large pieces of the precious metal shining among its pebbles and sands—such was the first hint afforded to the discoverer of the Anson mine. Unusually large pieces were found by those who first examined the place, and the highest hopes were inspired. On inquiry it was ascertained that part of the land was not held by a good title, and parcels of it were immediately *entered* *; but it has since been a subject of constant litigation, which has retarded the working of the mine.

* A piece of land is said not to be *entered* when it remains the property of the public, without taxation. Any one is at liberty to enter on the State books whatever land he can find in this situation, the land being secured to him on his becoming responsible for the taxes.

Reed's mine in Cabarrus is the one which was first wrought; and at this place, indeed, were obtained the first specimens of gold that were found in the formation. A large piece was found in the bed of a small creek, which attracted attention by its lustre and specific gravity; but it was retained, for a long time after its discovery, in the hands of the proprietor, through ignorance whether it were gold or not. This mine occupies the bed of Meadow creek, (a branch of Rocky River), and exhibits a level between two hillocks, which rise on either side of the creek, affording a space between from fifty to one hundred yards in breadth. This space has been nearly all dug over, and exhibits at present numerous small pits for the distance of one fourth of a mile on both sides of the stream. The surface of the ground and the bed of the creek are occupied by quartz and by sharp angular rocks of the greenstone family. The first glance is sufficient to convince the spectator that the business of searching for gold is conducted under numerous disadvantages, without the least regard to system, and with very little aid from mechanical contrivances. The process is as follows. During the dry season, when the greatest part of the level above described is left bare, and the creek shrinks to a small rivulet, the workman selects a spot at random, and commences digging a pit with a spade and mattock. At first he penetrates through three or four feet of dark-coloured mud, full of stones in angular fragments. At this depth he meets with that peculiar stratum of gravel and clay, which he recognises as the matrix of the gold. If the mud be very dense and tenacious, he accounts it a good sign; and if stains or streaks of yellow occasionally appear on the blue mud, it is a fortunate symptom. Sometimes he penetrates through a stratum of the ferruginous oxide of manganese, in a rotten friable state. This he denominates "cinders," and regards it also as a favourable omen. Having arrived at the proper stratum, which is only a few inches thick, he removes it with a spade

into the "cradle." This is a semi-cylinder laid on its side, (like a barrel bisected longitudinally and laid flat-wise), and made to rock like a cradle on two parallel poles of wood. The cradle being half filled with the rubbish, water is then laded in, so as nearly to fill the vessel. The cradle is now set to rocking, the gravel being occasionally stirred with an iron rake, until the coarse stones are entirely freed from the blue mud,—a part of the process which is the more difficult, on account of the dense adhesive quality of the mud. By rocking the cradle rapidly, the water is thrown overboard, loaded with as much mud as it is capable of suspending. The coarser stones are then picked out by hand, more water is added, and the same process is repeated. On pouring out the water a second time, (which is done by inclining the cradle on one side), a layer of coarse gravel appears on the top, which is scraped off by hand. At the close of each washing, a similar layer of gravel appears on the top, which appears more and more comminuted until it graduates into fine sand, covering the bottom of the cradle. At length this residuum is transferred to an iron dish, which is dipped horizontally into a pool of water, and subjected to a rotary motion. All the remaining earthy matter goes overboard, and nothing remains but a fine sand, chiefly ferruginous, and the particles of gold for which the whole labour has been performed. These are frequently no larger than a pin's head, but vary in size from mere dust to pieces weighing one or two pennyweights. Large pieces, when they occur, are usually picked out at a previous stage of the process.

Large pieces of gold are found in this region, although their occurrence is somewhat rare. Masses weighing four, five, and six hundred pennyweights, are occasionally met with; and one mass was found that weighed, *in its crude state*, 28 lbs. avoirdupoise. This was dug up by a negro at Reed's mine, within a few inches of the surface of the ground. Marvellous stories are told respecting this rich mass; as that it had been seen by gold-hunters at night,

reflecting so brilliant a light, when they drew near to it, with torches, as to make them believe it was some supernatural appearance, and to deter them from further examination. But all stories of this kind, as I was assured by Mr. Reed, the old proprietor, are mere fables. No unusual circumstances were connected with the discovery of this mass, except its being nearer the surface than common. It was melted down and cast into bars soon after its discovery. The spot where it was found has been since subjected to the severest scrutiny, but without any similar harvest. Another mass, weighing 600 pennyweights, was found on the surface of a ploughed field in the vicinity of the Yadkin, twenty miles or more north of Reed's mine. Specimens of great elegance, as I should infer from the descriptions of the miners, are occasionally found; but for want of mineralogists to reserve them for cabinets, they have always been thrown into the common stock and melted into bars. Mr. Reed found a mass of quartz, having a projecting point of gold of the size of a large pin's head. On breaking it open, a brilliant display of green and yellow colours was presented, which he described as exceedingly beautiful. The gold weighed 12 pennyweights. The mineralogist may perhaps recognize in this description a congeries of fine crystals, but on that point the proprietor could not inform me. Although fragments of greenstone and of several argillaceous minerals occur among the gravel of the gold-stratum, yet, in the opinion of the miners, the precious metal is never found attached to any other mineral than quartz. Indeed it is rarely attached to any substance, but is commonly scattered promiscuously among the gravel. Its colour is generally yellow with a reddish tinge, though the surface is not unfrequently obscured by a partial incrustation of iron or manganese, or by adhering particles of sand. The masses are flattened and vesicular, having angles rounded with evident marks of attrition. The rounded angles and vesicular structure lead to the opinion, which is very general, that the metal has undergone

fusion; but any one who inspects the specimens narrowly, will be convinced that their worn and rounded appearance is owing to attrition, and that the cavities are produced by the indentation of sand and gravel, the exact impress of which may be observed, and particles of them may still frequently be seen imbedded. The gravel, moreover, which is separated by washing, bears evident marks of attrition, of *a limited duration,* sufficient to round its edges and angles, but not sufficient to destroy them: the fragments are not ovoidal like the pebbles of rivers, but are still flat, retaining their original form, except that their edges are dull and their angles blunted. In short, the whole appearance is such, as would naturally result from so soft a substance as virgin gold being knocked about among such stern associates as quartz and greenstone.

The appearance of fusion, supposed to be exhibited by the gold, has inspired the idea among the miners, that the small pieces which they obtain have been melted out from some *ore* that lies disguised somewhere in the vicinity. This idea has frequently made them the dupes of imposition. The mineral rod, charms, and other follies, have had their reign here; and the first is still held in some estimation. The common rocks and stones of the country have been tortured by a new race of alchymists, who have imagined them to be the ore of gold, veiling, under some disguise, the characters of the precious metal. A great degree of eagerness also pervades the country on the subject of the metals in general. The minerals thrown out in excavating pits in search of gold, consist chiefly of quartz, greenstone, and hornblende mixed with chlorite, and afford little that is interesting to the collector of specimens. Almost the only substance which I met with, that was worth preserving merely as a specimen, was *pyritous copper.* Of this I saw some elegant fragments. It occurs in a gangue of quartz, and resembles that found at Lane's mine at Huntington, Con. (Amer. Journal of Science, vol.

i. p. 316.) A vein of it occurs in slaty clay, six miles east of Concord, in Cabarrus county. This ore had been subjected to numerous experiments, on account of the belief that it was the "ore of gold" above mentioned; and although the experiments did not lead to the discovery of gold, yet a "German miner and mineralogist" had, it was said, detected platina in it. On searching into the evidence of so unexpected a result, I was informed that a white metal was produced from this ore, which was not lead, nor tin, nor silver, but answered perfectly to the description of platina, although, as they acknowledged, it was easily fused, and burned with a blue flame. I suspected it to be *metallic antimony*, but still could perceive no signs of that metal in the ore. I requested a minute account of the process.—The materials, namely, the ore, charcoal, borax, &c. were put into a crucible—emetic tartar, in considerable quantity, was added to make the ore "spew out" the metal. Ipecacuanha was afterwards tried with the same view, but was not found to be strong enough "to make the ore vomit." After the account of the process, it was not difficult to account for the production of antimony, it being obviously derived from the emetic tartar.

At Concord, near the western limit of the gold country, the metal is found in small grains in the streets and gullies, after every rain; and the gullies frequently disclose the stratum of gravel and mud, well known as the repository of the gold. Washings on a more limited scale are conducted here. The clay is not so dense at this place as at Reed's mine, but more ferruginous and full of spangles of golden-coloured mica. This stratum rests on the *gneiss:* those before described were over the slate formation.

Parker's mine is situated on a small stream four miles south of the river Yadkin. As, in the instances already mentioned, excavations were numerous in the low grounds adjacent to the stream; but, at the time of my visit, the earth for washing (which was of a snuff colour) was transported from a ploughed field in the neighbourhood, that was elevated

above fifty or sixty feet above the stream. The earth at this place which contained the gold was of a deeper red than that at either of the other mines. The gold found here is chiefly in flakes and grains. Occasionally, however, pieces are met with which weigh 100 pennyweights and upwards; and very recently a mass has been discovered that weighed four pounds and eleven ounces. This is said to have been found at the depth of ten feet, which is a lower level than any I had heard of before. The idea of an aqueous deposit, which is apt to be impressed upon us whenever we either inspect the formation or reflect upon its origin, would lead us to expect, on account of the great specific gravity of gold, that the largest masses will be found at the lowest depths. But I am not aware that any uniformity exists in this respect. The largest mass hitherto discovered was, as has been mentioned already, found within a few inches of the surface. It is evident that the thin stratum which contains the metal will be buried at different depths by variable quantities of alluvial earth, that are accumulated over it by causes still in operation; and consequently, that the depth at which the stratum happens to be met with in any given place, is no criterion of its richness. Nor does the fact that this fortunate discovery was made at a lower level than ordinary, afford any encouragement to work lower than the usual depth. It might interest geological curiosity, however, to learn the nature of the strata below the gold deposit, although I do not know that the existence of this furnishes any reasonable grounds for supposing that there are other similar deposits below it. I could not find that any search had been made with such an expectation, except in a single instance. Near the spot where the largest mass was found, the earth was penetrated a few feet below the gold bed. Immediately beneath this was a thin layer of green sand, and next a similar layer of a bright yellow sand. These had a very handsome appearance, but neither of them seemed to contain any thing more precious than mica.

The terms on which the proprietors of the mines permit them to be worked, vary with the productiveness of the earth which is worked. Some of the miners rent for a fourth of the gold found; some for a third, and others claim half, which is the highest premium hitherto paid. The average product at Reed's mine was not more than sixty cents a day to each labourer; but the undertakers are buoyed up with the hope of some splendid discovery, like those which have occasionally been made.

The mines have given some peculiarities to the state of society in the neighbouring country. The precious metal is a most favourite acquisition, and constitutes the common currency. Almost every man carries about with him a goose quill or two of it, and a small pair of scales in a box like a spectacle-case. The value, as in patriarchal times, is ascertained by weight, which, from the dexterity acquired by practice, is a less troublesome mode of counting money than one would imagine. I saw a pint of whiskey paid for by weighing off three grains and a half of gold.

The greatest part of the gold collected at these mines is bought up by the country merchants at 90 or 91 cents a pennyweight. They carry it to the market-towns, as Fayetteville, Cheraw, Charleston, and New-York. Much of this is bought up by jewellers; some remains in the banks; and a considerable quantity has been received at the mint of the United States. Hence it is not easy to ascertain the precise amount which the mines have afforded. The value of that portion received at the mint before the year 1820, was 43,689 dollars. It is alloyed with a small portion of silver and copper, but is still purer than standard gold, being 23 carats fine. (Bruce, Mineral. Jour. i. 125.)

It will probably appear evident to geologists, from the foregoing statements, that the gold of N. Carolina occurs in a diluvial formation. Such indeed seems to be its usual bed; and, in this respect, it resembles the gold countries

of South America, of England, of Scotland, of Ireland, and of Africa. (Buckland, Rel. Diluv. 218—20.)

I have already adverted to an impression entertained by the inhabitants of our gold country, that the precious metal exists somewhere in the vicinity in an ample bed or vein, from which the pieces found are derived. It may not be uninteresting to enquire whether we can obtain any light respecting its origin.

1. *Is it brought down from the sources of the rivers?*

That this is not the case is evident, because it is not found merely in the beds of the rivers, but also in the neighbouring grounds, and that too whether the ground be plain or hilly. The formation in fact, crosses over hill and dale, and frequently the earth which is obtained on the hill side, or on the summits of an elevation of one or two hundred feet above the beds of the streams, is rich in metal. It is found on both sides of the Yadkin, and in the bed and throughout all the branches of Rocky River. It is evident, then, that the rivers do not bring down the gold from their sources, but that they cut through a stratum containing it, which covers, like a mantle, an extensive tract of the country through which they flow, and that they bring the precious metal to view by separating it from its stony matrix.

2. *Did the present lumps and grains ever form parts of large masses in a continued bed or vein?*

It has been already remarked that the present aspect of these pieces is such as would naturally result from collision among the siliceous fragments that accompany them. Impressions of sand and gravel, or even imbedded sand, might, it is true, be the result of fusion in a bed of sand; but the appearance is not that which arises from fusion under such circumstances, the cavities being superficial, forming impressions or indentations, while there is no appearance in any specimen that I have seen of a grain of sand enveloped by the mass*. But if the present appear-

* Vide Kirwan's Geological Essays, 402.

ance of these lumps and grains be owing to attrition, and the formation be, as we have supposed, a deposit from water, then we must regard them as the remains of larger pieces reduced in size by collision with the accompanying minerals, but not as parts of very large masses which have been torn up and broken into fragments. The same cause that would be sufficient to break up into fragments the accompanying gravel, would not break up large masses of gold into smaller pieces, since gold is soft and malleable, and not brittle and unyielding like quartz. The effect of running water and dashing rocks would be to wear down the pieces of gold and compress them, but not to break them. The fine flakes and dust of gold may be conceived to have been produced in this manner; and the relative quantity of dust may afford some means of judging of the original size of the lumps and grains from which it was derived. In the gold of this formation, but little dust, comparatively, is saved, although more, I believe, might be saved by a more improved process of working. At present the greater part collected is in the state of grains or small scattered lumps. The inference is, that this gold existed originally, that is, before its removal to its present position, in pieces somewhat larger than those found at present, but still of a moderate size. Whether these pieces lay contiguous to one another in a large vein, or whether they were flattened abroad in individual masses, it is, perhaps, impossible to decide. The fact that small veins have been found traversing quartz, favours the idea that this was the original mode of existence.

There are some circumstances which induce the belief, that the materials of the deposit itself were derived from the great slate formation before mentioned. The green mud may be supposed to have been formed out of the chlorite and argillaceous rock, with which the formation abounds; the greenstone pebbles correspond with a class of rocks of the same formation; and the quartoze fragments answer well in appearance to the larger fragments, that

are profusely scattered over the ridges of the slate country. Moreover, two masses of gold, each weighing several pennyweights, have been found in the county of Orange, over the same formation, 60 or 70 miles north of the gold region. Hence might be derived some faint hopes of finding the gold in native veins or beds; but still these may have been in the "fountains of the great deep" that were broken up.

If we suppose that gold dust is universally derived from diluvial action on lumps of the same metal, it will account for two well known facts;—first, the very general diffusion of particles of gold among the sands of all countries; and secondly, the circumstance of many rivers that were anciently auriferous, having now ceased to be so; as the Tagus, Po, and Pactolus. (Kirwan, Geolog. Essays, 402.) This author also adds, that it appears by the testimony of Disdoyn, that some of the rivers of France were much more abundantly auriferous in former ages than they are at present. The dust derived from diluvial action may be conceived to be exhausted or washed out in the course of ages, while there is now no process going forward for supplying the waste.

Obervations by the EDITOR

We think this excellent mode of *washing over* the earth, &c. *in a semi-cylindrical cradle,* is equally applicable to a great variety of other purposes of a similar nature; as in metallurgy, refining, &c. where the object is to separate the heavier particles from the lighter ones.

II.—*Description of an Hydrometrograph, or a Machine for measuring and recording the Quantity of Water, or any other Fluid, discharged within a given time from Conduit-pipes. Invented by the Chevalier* JOSEPH DE BAADER, *of Munich, in the Kingdom of Bavaria. Communicated by the Inventor.*

WITH A PLATE.

THE first idea of the hydrometrograph was conceived by the Chevalier, and communicated by him to various per-

sons in Bavaria, many years since. It arose from the generally acknowledged want of an exact measure for the quantities of salt water delivered and employed in different parts of the extensive royal salt-works at Reichenhall and Traunstein, with the management of which he was entrusted, and where the quantities of brine could only be *computed* by the ordinary means, in such an imperfect manner, that errors of one half the quantity passed could neither be avoided nor detected.

The means formerly made use of for this purpose, at the Bavarian salt-works, and which are generally known, consisted in employing a certain number of gauge-pipes, or orifices, placed in a horizontal line, in the side of an oblong prismatic vessel; and in which, by the opening or shutting more or fewer of those orifices, the surface of the water was endeavoured to be constantly kept at the same level or height in the vessel, so that its surface might form exact tangents to the circles of the apertures through which it issued; and there is no doubt, that an apparatus of this kind, properly adjusted, and diligently attended to, is very useful for ascertaining, at any moment, the *rate* at which the water is delivered; at least equally accurately as the log, when thrown overboard a ship, shows the rate at which the ship is sailing, *at the time of the observation.* But it is evident, that unless the supply or delivery of the fluid be perfectly uniform and constant, which can hardly ever be the case, this method is quite insufficient for ascertaining, with any precision, the whole quantity of the fluid delivered in the course of a day, a week, or a month; as each apparatus would require the constant attendance of a person to regulate the level of the water in the gauging-vessel, by opening or closing the orifices of the gauge-pipes, according to the diminution or increase of the supply; and, at the same time, to observe and keep an exact account of each change or interruption which takes place; and the final result of all this labour would only be a complicated calculation, liable to many errors, and, of course,

not to be depended upon. It was, therefore, a most desirable object, to invent a perfectly correct and infallible measurer of the quantity of fluid delivered in any given time, independent of every inequality or interruption of the supply, which would require no attendance whatever, and would record by its own mechanism the number of cubic feet of fluid delivered, from the commencement of the operation, without any other trouble to the observer, than merely writing down the numbers indicated by certain indexes upon dial-plates, in a decadic order.

An experience of many years has proved that this object has been obtained in the most successful manner, from the general use of these hydrometrographs in the Bavarian salt-works; and to the conviction of thousands of strangers, who have seen those works.

With respect to the application of it in this country, as it can be constructed upon any scale, either for measuring the largest quantities of water or other fluids, or the smallest, so there are numerous instances where such an apparatus might be highly useful; as, for registering the quantities of water delivered from water-works; the daily supply of a stream of water, employed in actuating a water-wheel, or in the irrigation of a piece of land; in measuring and recording the quantities of wort or beer in breweries; and of brandy, or other valuable liquors in distilleries, &c. even down to pints and cubic inches, to the greatest nicety. Nay, a machine of this kind, constructed upon a small scale, might be usefully employed in meteorology, as a convenient and elegant measurer of the quantity of rain fallen every week or month throughout the year.

Description of the Machine.

In plate I. figs. 1 and 2, *a a* are two square vessels, each capable of containing more than five cubic feet of water or other fluid; these are partly filled and emptied alternately, in the following manner: *b* is a moveable trough, mounted upon an axis, into which the water is

received from the pipe or main, *c*; in each of the vessels, *a a*, is a hollow float of copper, *d d*, which, rising with the water, by means of an adjustable stud, *e*, (shown separately in fig. 3), sliding upon the stem of the float, gives motion to a tumbler, *f*, which, by means of the arm, *g*, connected with a rod, *h*, descending to the trough, *b*, reverses it, and causes the water to flow into the other vessel, at the same time opening a conical valve, *i*, at the bottom of the full vessel, and discharging the water through it. When both vessels have been filled and emptied, a stud, *j*, upon the upper end of the stem of one of the floats, moves a lever, *k*, turning upon an axis, and having a counter-weight at its opposite end, and a catch, *l*, near the other end of it, which moves a ratchet-wheel, *m*, having ten teeth around it, one tooth; and which gives motion to a train of five pinions, of six teeth each, and four wheels with sixty teeth each; on each of the five arbors are indexes, which show upon as many dial-plates, divided into ten divisions each, and numbered, any quantity of fluid which may have passed as far as 100,000,000 cubic feet, without any attendance, or the possibility of committing an error;—*n* is a check-spring, acting in the teeth of the ratchet-wheel *m*.

The tumbler, *f*, consists of a wooden bar, mounted upon an axis in its centre; it turns up at each end, and two iron rods, *o o*, are passed through the ends, and secured by screws and nuts: these rods serve as guides to conduct a cast-iron ball, *p*, from one end of the tumbler to the other alternately; and which ball strikes and rests against leather pads or cushions, *g*, which are provided at each end of the tumbler to receive it. On the underside of the tumbler are two blocks, *r r*, against which the studs, *e e*, on the stems of the float act; and when either end of the tumbler is raised to the position shown by the dotted lines, *s s*, the ball suddenly runs down, and, by its momentum, strikes upon one of the ends of a lever, *t*, turning upon an axis in its centre, and from each end of which rods descend, to which the conical valves are hung, and thus suddenly

opens one valve and shuts the other; at the same time assuming the position shown at *v v*. There are two cast-iron blocks, *u u*, fixed underneath the tumbler, to strike upon the ends of the lever, *t*. Gaps are made in the inner edges of the copper floats, to permit the rods of the valves to pass freely by them. The whole machine is surrounded and enclosed in a proper manner, and strengthened by framing, but which need not, however, be particularly described here.

III.—*On the Processes of Tanning, Leather-dressing, and Dyeing, &c.*

(*Concluded from page* 357.)

ON CURRYING LEATHER.

THE common mode of currying leather for shoes, boots, &c. consists in first softening the hides, as they come from the tan-pit, partly by soaking in water, partly by mechanical means, and then impregnating the leather with some kind of oil, by which means, it is rendered much more impervious to moisture, and proper to protect the feet from the inclemency of the seasons. The process, in a few words, is the following: the hide is first soaked thoroughly in water, then placed on a polished wooden beam, with the flesh side outwards, and pared with a broad sharp knife, till all the inequalities are removed, and it is reduced to the required thinness. It is then again washed and rubbed with a polished stone; and while still wet, it is besmeared with curriers oil, generally fish-oil, or a mixture of this and tallow. When hung up to dry, the moisture evaporates, and the oil, which cannot be dissipated by mere exposure, gradually takes the place of the moisture, and penetrates deeply into the pores of the leather. It is then dried, either in the sun, or in a stoved room.

Blackening the leather, is also a part of the currier's business, which is done on the grain side, simply by

rubbing with an iron liquor; but on the flesh side with a mixture of lamp-black and oil.

Shammoyed Leather.

This is generally sheep or doe's-skin, prepared in the way already mentioned, viz. by dressing, liming, &c. This forms the common wash-leather, breeches-leather, &c. and is the only kind, which, when dyed, will bear washing, without the colour being materially injured.

Common boot-leather, as usually prepared, is still, in some degree, pervious to water, by long exposure to wet; and therefore fishermen, wild-fowl shooters, and those whose employment or amusement leads them to be long on wet ground, usually prepare their boots with an additional dressing of some oily or resinous matter.

Mixtures to render Leather Water-Proof.

The punt-shooters in Cambridgeshire, and the adjoining fenny parts of England, use the following mixture, with very good effect*. Melt together, in an earthen pipkin, half a pound of tallow, 4 oz. of hogs-lard, 2 oz. of turpentine, and as much bees-wax; make the boots thoroughly dry and warm, and rub in this mixture well, with a little tow, as hot as the hand can bear; or else hold the boots over a very gentle fire, till the leather has thoroughly imbibed it. Another mixture for the same purpose, and used by fishermen, is, bees-wax, Burgundy pitch, and turpentine, of each 2 oz., tallow, 4 oz.; or, half a pound of bees-wax, a quarter of a pound of resin, and a quarter of a pound of beef-suet. In all cases, the boots must be quite dry, and the mixture applied very warm.

It only remains, on the subject of leather, to notice very shortly, some of the most remarkable kinds of leather, prepared in foreign countries; for the general methods of making leather resemble each other very closely in every part of the globe.

The process for the real Morocco Leather, as prepared from goat-skins, at Fez and Tetuan, is thus described by

* Daniel's Rural Sports.

M. Brouffonet*. The skins are first cleansed, the hair taken off, limed and reduced with bran, nearly in the same way, already described, for the English Morrocco leather. After coming from the bran, they are thrown into a second bath, made of white figs, mixed with water, which is thereby rendered slimy, and fermentable. In this bath the skins remain four or five days, when they are thoroughly salted with *sal-gem* (or rock salt) alone, (and not with salt and alum), after which they are fit to receive the dye, which, for the red, is cochineal and alum; and for the yellow, pomegranate bark and alum. The skins are then tanned, dressed, suppled with a little oil, and dried.

Russia Leather.

Much excellent leather, of every kind, is prepared in different parts of the Russian empire. The preparation of the fine Russia leather, so well known, for its quality, and for its peculiar smell, is described at large in Mr. Tooke's "View of the Russian Empire†," to which we must refer our readers, for the minuter particulars. In general, it may be stated, that the hides are first put into a weak alkaline lye, to loosen the hair, and then scraped upon a beam; then, (if calves), are reduced by dogs'-dung, and a sour oatmeal bath; then tanned with great care, *and frequent handling*. The bark used here is seldom oak; but where it can be got, the bark of the black willow; or, if this cannot be had, birch-bark. They are then dyed either red or black, these being the two colours most esteemed. For the red, the hide is first soaked in alum-water, and then dyed with Brazil-wood. The black is given, as usual, with an iron liquor. The leather is then smeared with *birch-tar*, which gives the peculiar smell, so much prized, (and which, when used for book-binding, has the valuable property of protecting the book from worms), and is finished by various other manipulations. The streaked or barred surface, is given to the

* Bulletin des Sciences. † Vol. III. page 514.

up with the flesh side inwards, and pressing each skin with a considerable weight, for about twenty-four hours, in which time, the sal-ammoniac dissolves enough of the copper to penetrate the skin with an agreeable sea-green colour. This is repeated a second time, to give the colour more body.

Blue shagreen is dyed with indigo, dissolved in an impure soda, by means of lime and honey. *Black shagreen* is dyed with galls and vitriol. The skins are finished with oil, or suet.

IV.—*On the cultivation of Asparagus during the Winter. By Mr.* PETER LINDEGAARD, *Gardener to his Majesty the King of Denmark, at the Royal Gardens of Rosenburgh; and a Corresponding Member of the London Horticultural Society*.*

ON THE CULTIVATION OF ASPARAGUS.

MUCH diversity of opinion prevails amongst gardeners on the continent, relative to the *cultivation of asparagus.* Though much on this subject, by experienced gardeners, is treated of in the Transactions of the Horticultural Society; I nevertheless venture to offer some instructions on the same subject, but particularly on *forcing asparagus in the winter,* by means of horse-dung, in beds in the open air, without frames or lights; which method I have practised more than thirty years. I shall first proceed to describe my mode of forming new plantations, which is that generally practised in Denmark.

I prepare every year a piece of ground, for four or six beds, in the most eligible situations; destroying, at the same time, an equal number of old and exhausted beds. The soil I prepare for the purpose, is a light loam, rather sandy; this is trenched in the autumn, about four feet deep; in the bottom of the first trench is thrown a layer of old decayed horse-dung, about six inches thick, upon

* From Vol. V. part V. of the Society's Transactions.

this a layer of earth, taken from the next trench; and so proceeding alternately, with an equal layer of earth and dung, till the whole is finished. In trenching the ground the earth is thrown up in high ridges; being thus more exposed to the atmosphere, during the winter.

In the following spring, when the frost is quite out of the ground, and the soil is fit for working, the whole is trenched, and well worked with a fork; being thus well mixed together, it is then levelled, and divided into beds. I allow four feet for a bed, and two feet for the alleys; two rows of asparagus on each bed, and the plants two feet apart. In each end of the beds are driven two pegs, to indicate the margins, when the alleys are subsequently to be dug up.

I always use one year old plants, which, indeed, is the usual practice with us; and is preferable to sowing seed in the bed, to remain; by which a whole year is lost. The holes for receiving the plants must be at least eight inches in diameter, and four inches deep, formed into a hill in the centre, whereon the plants are laid; after all their roots and fibres are spread out in the holes, they are immediately covered with good rich mould, full four inches above their crowns. Some gardeners will not admit any other vegetables to grow on their asparagus beds; I have, however, the first year, taken a small crop from the beds, either a row of early radishes or lettuces; or drilled a row of onions, of the large Spanish kind, just in the middle of the beds, where it only occupies a space four inches broad, which I have not found to do the least injury; for the roots of such vegetables do not extend deep into the ground. The second and subsequent years, no vegetables whatever ought to be sown or planted upon the beds. In the autumn, when the tops are cut off, (one inch under the surface of the ground), the beds are to be stirred up with a fork, very carefully. A line is then drawn from peg to peg, for digging up the alleys, about six inches deep; and the earth from them is thrown upon the beds.

The alleys must afterwards be again filled to the top with old rotten dung, which will be fit to lay in the beds again, the succeeding autumn. This practice must be repeated every autumn, in order to heighten the beds; that the shoots may have their proper length, when they are to be gathered.

Asparagus being thus managed, and kept clean from weeds, will be fit for gathering in the fourth season; but should be sparingly cut that year: some gardeners begin gathering in the third season, but this weakens the plants. Some of our market gardeners cut their asparagus twice a day; for they are not so well esteemed when the tops or heads are become green *.

Every one who has visited Holland, and paid the least attention to horticulture, knows that the soil in the environs of Haarlem, and the greatest part of North Holland, is pure sand; but asparagus succeeds there extremely well. Dung is not, however, spared by the Dutch, who treat asparagus in the same manner as we do; and I have observed that their asparagus, as well as every other vegetable, is particularly tender and palatable. Whether this excellence is derived from the soil, or the moist and nutritious sea-air, I am not able to decide,

On the forcing of Asparagus.

I shall now proceed to describe *my method of forcing asparagus.* For this purpose, I select the best beds which are left uncut, in the preceding summer. The period at which I have to deliver my chief crop, is always fixed; it is the king's birth-day, which happens on the 28th of January. Forcing is, consequently, commenced four or five weeks before that date. A great deal of fresh

* Mr. Baumann has suggested cylindrical pots, or pipes, eighteen inches high and one inch in diameter, to put over the shoots; but I think these would be turned over by high winds; and would, besides, in extensive plantations, be attended with much trouble. See *Horticultural Transactions*, Vol. V. p. 334: and Vol. V. p. 220, of the *Technical Repository*. The Dutch are likewise fond of white asparagus; and they cut them also early in the morning. I have even seen, in some places, those shoots which appear in the middle of the day earthed up, to preserve them white till the next morning. I have followed this mode with some of my beds.

horse-dung, having been collected before hand: the beds which are destined to be forced, are usually four, measuring about forty feet in length each. It is necessary to remark, that when severe frost is likely to occur, before forcing is commenced, the beds must be covered with a layer of litter or leaves, to keep out the frost. The beds are first stirred up loosely, with a fork; and the surface spit of the alleys is thrown on them to heighten them; for the crowns are sometimes so near the surface, that it is otherwise impossible to get the shoots of a proper length. The alleys are then cleared out, to the depth of about three feet and a half, and hot dung immediately put into the cavities, and raised up as high as a foot and a half above the level of the tops of the beds; after being trod a little, and made level, it is covered with some old boards, or planks, which keep in the heat more regularly, and are useful for treading upon when the asparagus is to be gathered. In the middle of each bed is placed a narrow board, on which a man, when gathering, may place one foot, whilst his other foot goes close along the lining. When the alleys are filled up with the fresh horse-dung, the beds must be covered with litter, or with some of the same dung, about three or four inches thick, more or less, according to the state of the weather.

Both ends of the beds must likewise be provided with a lining of fresh dung, as deep in the ground as the alleys. The whole being thus ready, nothing more is to be done, but, from time to time, to observe the temperature of the beds. I usually put some sticks into them, by which the increasing heat may be observed. In a fortnight after the whole is finished, a few shoots will make their appearance, —the first gathering will then take place; a man, who walks on the top of the linings, throws the dung or litter from one half of the bed, upon the other side, so far, that a man who gathers can put one foot upon the narrow board in the centre, and the other on the lining. Two men come immediately after, on the other side, to remove the

litter from the opposite side; and a man follows, to gather. The litter must, as soon as possible, be spread on the beds again. The beds will afford but few shoots till they become warm. It will be necessary, every third day, to examine the temperature of the beds, that the shoots may not grow too long; when the beds are not over-forced, they will continue to produce asparagus for five or six weeks.

When gathering has ceased, or rather, on the approach of spring, it will be advantageous to the roots of the asparagus, to remove the dung from the alleys, and fill up the cavities with good rich mould; for the new roots, which the plants emit in the summer, cannot extend themselves in the dung which was employed for forcing, as it will be bound together in a compact mass. The dung must likewise be taken off from the beds, and they are then to be raked over; there will still appear some shoots in the spring, which are to be left for the support of the roots during the summer.

The quantity of asparagus which may be expected from four beds, of the abovementioned size, depends much on the state and age of the plants. I had, for instance, last year, (1822), on his majesty's birth-day, January 28th, two thousand seven hundred fine asparagus, which the British minister, the Right Hon. Augustus Foster, witnessed on the day they were collected*; and the beds, for a fortnight after that, yielded some fine asparagus. I thus calculate the whole produce at four thousand, exclusive of small ones.

I am induced to believe that, in a country where this vegetable is in demand, the cost of this mode of cultivation would be amply repaid; and, particularly, in a season when other vegetables are scarce. It is true, the requisite quantity of dung will cause much expense; but, after

* The asparagus, when gathered from time to time, must be put into dry sand, in a cellar or green-house, not laid flat, but always placed upright, in regular rows; where they will keep fresh and good for a fortnight or three weeks.

it has been used for that purpose, it is not lost. After the beds have yielded their crop, I collect all the dung which was laid on them, and a good layer from the tops of the alleys; this I mix with fresh dung from the hot-beds, and find it very useful in the spring, when dung is much in demand. Asparagus plants, thus forced, are, in some measure, injured, but by no means destroyed; three seasons being necessary for their restoration; after which they may be again forced successfully. When asparagus is intended to be forced later, as, for instance, in the beginning of February, less dung is wanted, as the alleys require it to be only to half their depth; and less covering on the beds is required, for nature assists art at that season.

Our market-gardeners, who force asparagus for sale, apply half sea-weed *(fucus vesiculosus)* and half horse-dung; which, when the season is a little advanced, does very well. Gardeners who live near the sea-coast, where horse-dung is scarce, apply sea-weed alone for hot-beds, small peach-house linings, &c.; it attains a high temperature, but does not retain it long: it is well adapted for late crops on hot-beds.

I will offer a few observations on Dr. Forbes's account of the mode of raising asparagus at Vienna*.

His method of preparing the soil for asparagus is the usual mode pursued in this country, except that the layer beneath, in the trenches, consisting of "dung, horn-chips, wood-chips, bones of cattle, ox-horn, and decayed branches of shrubs or trees," is not used. The latter vegetable materials I consider very good; but I doubt whether the animal substances can be useful to so succulent a plant as asparagus, which rapidly draws up its nutriment from the soil, without extracting it gradually, as in the case of the vine: there, the nutriment, whatever it may consist of, is divided and retained in the vessels, long before it reaches the fruit. It is also a question with me, whether such animal matters may not have some influence on the taste

* See Vol. V. p. 221, of the *Technical Repository.*

of the asparagus. It is a well known fact, that vegetables which grow beneath the soil, such as carrots, potatoes, &c. are more or less palatable according to the circumstances of the soil in which they are produced.

I also object to the plan of sowing the seed a foot below the surface. I believe every experienced gardener will agree with me that this depth is too great.

V.—*On the impolicy of Legalizing the Exportation of British Machinery to the Continent.*

In our sixth volume, we thought it our duty to lay before our readers, various extracts from the Reports of the Select Committee of the Hon. the House of Commons, "on Artizans and Machinery," containing the opinions of many eminent engineers, manufacturers, &c. on the above important subject.

We find the subject was again brought before the notice of the House of Commons on Tuesday the 14th of June last, in consequence of Mr. Littleton stating, that he had a petition to present, which was entitled to the serious consideration of the House; *it was from the artizans of the town and county of Nottingham; and they prayed that Parliament would not repeal the laws which prohibited the exportation of machinery. The petitioners declared their conviction, that it was this prohibition of the export of the perfect machinery, used in so many important branches of the manufactures of this country, which had made the trade of England the admiration of the world. The petitioners enumerated the numbers and value of particular machines used in the manufacture in which they were interested, and forcibly urged the local and general advantages which had arisen from their being kept in this country. If the law, which has operated hitherto with so much advantage, were now to be repealed, the country would have to rue such an experiment, for it would necessarily drive artizans to accompany their ma-*

chinery to foreign states. Thee hon. member enforced the prayer of this petition, and thought that if any alteration of the old law were intended, it ought to be left in the power of the Board of Trade to licence or prohibit the export of machines of a particular nature.

Mr. Birch strongly concurred in recommending this petition to the favourable consideration of the house.

Mr. Huskisson entirely concurred in the importance of a subject which had so excited the feelings of the artizans of this country; but were he to express a general opinion on a subject upon which a committee were now sitting, he would say, that the continuance of the laws in their old state, to which so many of the artizans appeared attached, was inconsistent with the more liberal policy in trade, which the country had recently adopted. Still, however, he would by no means recommend any serious alteration, without the fullest consideration; and more particularly, without hearing the opinions of those practical men, who ought, perhaps, to be the best judges, of what seemed the most likely to affect their interests in several trades. It would be very well for the committee to hear all the information which practical men were capable of affording upon the subject; and then they could enlighten each other on the general topics which such a consideration involved. For instance, the artizans entertained a general opinion, that the great advances made by the manufactures of this country, were owing entirely to the perfection of their machinery. How far that could be deemed the sole cause, or whether it was connected with other causes, it would be right to determine. And he repeated, that no alteration ought to take place without the most mature consideration. Still, the house ought to consider, that they had, to a great extent, acted upon the principle of the free circulation of labour; and it would be difficult for them to stop altogether respecting the case of machinery; and particularly, when the case of patents in this country so nearly resembled the

law upon the same matter in France and in the Netherlands, the countries of which the artizans were most jealous. When an artizan took out a patent in England, he mostly provided himself with the same safeguard in those two other states. He was most disposed, *considering the great alarm which pervaded the manufacturing interests on this subject*, to treat the matter with as much delicacy and caution as possible, and by no means to act without farther and fuller enquiry. He could not, however, concur in his hon. friend's recommendation of referring the subject to the Board of Trade; for that Board had already more than enough of business on its hands; and if the further delay were imposed upon them, of deciding what articles of machinery should be exported, and those on which an embargo ought to be laid, then they would assign to the Board of Trade an invidious and unpleasant duty, for which, as at present constituted, they were totally unfit.

Mr. Hume said, that as one of the committee upon machinery, he quite agreed in the importance of the subject, and that all parties ought to be fully heard before the law was altered; although nothing had occurred to alter the opinion he had long formed, that the laws relative to the export of machinery ought to be made to partake of the general improvement in the principles and policy of trade. Still he confessed, *that he meant not to press, at this moment, a repeal, against the prevailing state of alarm that was manifest, which, otherwise, he had intended to propose.*

We are truly glad to find that the artizans of this country are at length aroused to a sense of the danger in which they would be placed from the repeal of the laws prohibiting the exportation of machinery; and also to learn, that, in consequence of the prevailing alarm, it is not Mr. Hume's intention to press the repeal of those laws at this moment. We congratulate ourselves in having done all in our power to bring this highly important

question before the notice of the public; and trust, that should it be presevered in, the artizans and manufacturers will load the tables of the house with petitions against it. At present the country is suffering under the consequences of permitting artizans to export themselves and their knowledge to other countries, in the great want of workmen to execute the prodigious demand for machinery existing every where; and very many of the artizans themselves, who have so acted, disgusted with the different modes of living on the Continent, to which they cannot bring themselves to submit, and also finding that they are no longer held in that estimation after having communicated their knowledge, which they deluded themselves in the hope of possessing, are now become heartily tired, and only wish to have the means afforded them of a speedy return home; and, indeed, as such is the actual want of artificers in this country, it would be good policy in the government to supply such means with as much promptitude as possible.

With regard to permitting the free exportation of machinery, we must say, that *the possible advantages of it* are very trivial indeed, compared with *the actual mischiefs* it would inevitably bring upon us. It might, indeed, benefit at first a few machine-makers, (who however do not need additional orders, having already more than they can execute for want of hands); but as manufactories similar to our own, for the fabrication of machinery, now exist, and are rapidly extending upon the continent; so, after being supplied with *pattern machines*, they would no longer apply to us for more machinery, but make it for themselves.

VI.—*On the Steam Engines in Cornwall.*

We have lately been favoured with a recent monthly report, of Messrs. Lean's, on the quantity of work performed by fifty-three engines in lifting water, with each bushel of

coals; from which it appears that an engine of Mr. Webb's construction, at the Barton mine, lifted 43,270,713 pounds of water, one foot high; the load being 18,914 pounds per each square inch, in the cylinder. We also find one of Mr. Woolfe's construction, at the Wheal Alfred mine, lifted 41,058,808 pounds, one foot high, with a load of 71,658 pounds per inch; and several others lifting between thirty and forty millions of pounds, at various loads, per inch. There are also reported, twelve steam-engines employed in drawing ores, and four in stamping ores, thus making a total of sixty-nine reported steam-engines employed in the Cornish mines.

It should, however, be remarked, that these *reported* steam-engines, are by no means the total numbers of steam-engines employed in Cornwall; and there are besides many water-wheels of large diameter, employed in pumping, &c. as well as *pressure-engines*, working by the power of columns of water, employed as steam is, in the steam-engines.

We are just now informed of a water-wheel being erecting at the Wheal Harmony mine, of *fifty feet in diameter*, and which is intended to assist in working the pumps employed in freeing that valuable mine from water.

THE

TECHNICAL REPOSITORY.

VII.—*On Screw-stocks, Dies, Taps, Screw-plates, &c.* *By the* EDITOR.

WITH A PLATE.

ON AN IMPROVED SCREW-STOCK AND DIES.

THE great requisites of a good screw-stock, are simplicity in its construction, facility in fitting the dies into it, and the perfectly steady movement of the dies in the stock. The first of these considerations is of some importance, but it is highly necessary that the dies should be easily fitted to it; as the opportunities of obtaining dies from the loan of taps of superior excellence are very frequently lost, owing to the great difficulty of forming and fitting dies into the screw-stocks in common use; and we are fully convinced of the necessity of securing the utmost steadiness of motion to the dies in the stocks, in order to cut perfect screws.

Amongst the great variety of screw-stocks and dies we have met with, we have found none that possess the above qualities in so great a degree as those we are about to describe; and which, although not intirely unknown, are yet in but few workmen's hands. We trust, that our description of them may tend to bring them into that general use which their excellent properties so well merit.

Our attention was first directed to these screw-stocks and dies by the late scientific Mr. Samuel Varley, whose name our readers are already well acquainted with, from the frequent occasions we have had to mention him: he obtained his knowledge of them from a workman of his named Phillips; but he did not know that he was the in-

ventor of them. We have since then met with a set, amongst the effects of a late ingenious watchmaker.

The addition of the excellent adjusting screw and index to the stock, and which are the invention of Mr. Robert Gibson, an ingenious watch-maker of Hampstead, is, however, due to ourselves. He had applied them to a screw-stock of his own, with great advantage; and we think the present one only needed this addition to render it complete.

In plate II. fig. 1 is a front view of the screw-stock, dies, adjusting-screw, index, and the wedges, of their size, as made by the Editor for his own use. The frame, *a a*, and the head of the adjusting-screw, *b*, are made of gun-metal; and the ball, *c*, at the end of the handle, is contrived to balance the weight of the adjusting screw-head. Fig. 2 is a side view of the several parts above enumerated, with the omission of the handle and ball; and fig. 3 is a section, taken at the dotted line, *d e*, in fig. 1. In all these figures the same letters of reference indicate the similar parts. The frame, *a a*, of the stock has a long aperture, *f f f f*, made through it, the sides being exactly parallel to each other, and, as well as the ends, at right angles to the flat faces of the frame. A flat plate of steel, *g g*, fig 2, is firmly rivetted to the underside of the frame, which has also an aperture, *h h*, made in it, not so long as the aperture, *f*, in the frame, nor so wide; the sides of it projecting a little, as shown in the section, fig. 3, at *i i*, and by dotted lines in fig. 1. Upon these projecting sides, *i i*, the fixed die, *j*, and the moveable die, *k*, rest, and are supported underneath; their sides being in contact with the parallel sides of the frame. The dies, *j j* and *k k*, are held down in the frame by the hardened and tempered steel tapering bars, or wedges, *l* and *m*, which are let into the dove-tailed gaps, *n o*, fig. 2, made in the upper face of the frame to receive them. These wedges lodge in the depressions, *p q*, which are made across the dies to receive them, and as shown in figs, 4 and 5, which are a top and edge view of the die, *k*. The depressions, *p q*, in the dies, are made rounding a little, as shown in the section,

fig. 3; so that the wedges shall always press upon the middle of each die; and thus, by the action of the wedges, they are kept perfectly steady in the frame, resting below upon the projecting ledges, *i i*, fitting accurately the sides; and, by their length, which is much greater in proportion to their width than in the dies of the usual construction, they are rendered incapable of any other movement in the frame, than the sliding one necessary to their use. And, indeed, the die, *j*, may be immoveably fixed in the frame by the pressure of the wedge, *m*, upon it; whilst the other, *k*, may be made to slide with more or less freedom, accordingly as the wedge, *l*, is driven more or less tight upon it; and they may instantly be taken out of the stock by striking out the wedges. It will be seen that the fixed die, *j*, is not so long as the moveable one, *k*. The thickness of the dies must be such, that their ends, in which the portions of the female screws are sunk, shall rise a little above the wedges, as shown in figs. 2 and 3, so that a screw may be tapped close to its shoulder. The moveable die is pressed towards the fixed one by means of the adjusting-screw, *r*, which acts in a female screw, made in the head of the frame; the point of this screw is received into a hole, sunk partly through a block of iron, *s*, which lies in the upper end of the aperture, *f*, and prevents the screw from injuring the die, *k*.

The head, *b*, of the adjusting screw, *r*, is made cylindrical, and has a helical or spiral, *u*, traced upon it, like the screw; by holding a pointed tool in contact with it whilst it is turned round, the screw itself serving as a guide in forming the spiral. The head has also ten straight divisions made around it, numbered from one to ten. An index, *v*, secured to the frame of the stock, either by a dove-tail slider, as here shown, or by screws, accurately points out any required position of the screw, *r*. Thus, in tapping a screw, the tap being placed within the dies, and the adjusting-screw turned until the dies close upon the tap; the straight division next the side of the index must be

noted, and also the number of helical divisions above the end of the index. We have then only to cut the cylinder intended to form the screw, with the dies, and turn the adjusting-screw until the divisions upon its head again coincide with the before observed ones; and the screw will then be sure to fit the female screw it is to work in at once, and without requiring to be repeatedly taken out of the dies, and tried until it will fit, as is generally the case.

It will be seen, that the dies used in this screw-stock are readily formed out of a bar of steel, made of a proper breadth and thickness, as shown in fig. 6; and require no greater accuracy than a good common workman is fully capable of bestowing upon them. The ends of the dies may receive the indentations of either one or two screws upon them, as shown; gaps being filed across them previously to the screw-tap being inserted; and the adjusting screw being turned from time to time, as the work proceeds, and the tap turned round in the dies, they will very soon receive the impression of the screw; after which they must have proper notches made in them, and be hardened and tempered for use, as usual.

ON ORIGINAL AND OTHER TAPS FOR SCREWS.

These generally consist of short cylindrical screws, capable of being fitted into a lathe, so as to be turned in it at the time they are forming the dies; as, thereby, the liability of their becoming irregular, or drunken, as it is termed, is considerably lessened; and, indeed, where it can be done, it is better to cut the screws themselves in the lathe, by means of dies; as, thereby, such irregularities may often be avoided, or at any rate become evident.

These original taps have gaps or furrows made along and obliquely across them, as shown in figs. 7, 8, and 9, to enable them to cut the dies; and are left quite hard, not being tempered.

Although, strictly speaking, no dies ought to cut any other sized screws than those they were originally made with, yet it is often desirable to be able to employ them of different diameters. In this case, all that the dies can do,

will be to afford us the divisions of the threads, as the screws will be more or less blunted by the crossing of the dies; and, therefore, we must deepen the threads afterwards in the lathe. This is effected by employing a kind of file, made of a piece of hard steel, shaped somewhat like figs. 10 and 11, the angular sides being roughened obliquely, in the manner shown in fig. 11, by means of a coarse file. This being held upright, and in a proper direction upon the screw between the threads, whilst turned in a lathe, and repeatedly passed along it, will deepen the threads; and, if the edge should happen to become notched a little in use, this is even thought to assist in the operation.

[*To be continued.*]

VIII.—*Directions for the management of such Hot-house, &c. Fire-places, as are constructed with Double Doors and Ash-pit Registers. By* WILLIAM ATKINSON, *Esq. F. H. S.**

WHEN the fire is first lighted, the ash-pit door may be left open, till the fuel be properly kindled; the doors should then be shut close, leaving the brass register so far open as to allow sufficient air to enter to blow the fire, but not more than is absolutely necessary to make it burn well, not violently, nor with a strong draught; for, if more air be admitted than is required for a moderately brisk fire, it occasions a great waste of fuel, without increasing the heat.

The fire-place door must, at all times, be kept shut; and the sloping part of the iron frame of the door must be kept clear of coals, so as not to prevent the door from latching. No air must be let in at the door at any time, except when it cannot be avoided, in feeding the fire. Any cold air that may get in at the fire-place door, is apt to rush over the fire, and get into the flue, without being heated; and that air tends to cool the flue, instead of heating it.

* From Vol. V. part IV. of the Transactions of the London Horticultural Society.

Therefore, all the air that is necessary for blowing the fire, must be admitted at the ash-pit register; in order that it may get heated, in passing through the fire to the flue.

It is impossible to determine the exact opening necessary to be left in the ash-pit register, to admit sufficient air; as this greatly depends upon the goodness and length of the flue, and the height of the chimney. When a flue is once properly heated, the draught becomes stronger; and then a less opening in the register is sufficient to supply the fire with air. In this state, about half an inch opening in the register is generally sufficient; and it should be shut quite close, if it be found that the fire will burn with it in that position; as a considerable quantity of air will get in through the joints of the ash-pit door.

The best fuel for hot-house fire-places, is about equal quantities of coal and small cinders, or braise. This is cheaper than using coals only, and keeps up a steadier fire, with less smoke.

At all times when fresh fuel is added to the fire, the hot unconsumed fuel must be pushed with an iron rake towards the further ends of the bars; and fresh fuel be applied immediately in front of it, so as to fill up the space between the bars, and the inner part of the frame, of the double door.

This fuel being dead, between the bars and the door; it protects the door from the heat of the fire, and prevents the iron from warping.

In supplying the fire with fresh fuel, great care must be taken not to throw it over to the further end of the fire, or into the throat of the flue; for this is often the cause of flues bursting. When coals are thrown beyond the fire, after it has burnt low, and the flue is hot, the heat of the brick-work distils gas out of the coals; this gas gets into the flue, and, when the fuel over the fire becomes inflamed, if the flame be drawn into the flue, it ignites the gas that has been there generated, and causes an explosion. This ought to be particularly attended to, as an

explosion of gas in the flue may destroy a valuable collection of plants in a moment.

There is also another circumstance which renders it desirable to attend to the manner of supplying the fire with fuel. If the fresh fuel be thrown over the whole surface of a hot fire, it produces an immense volume of smoke and blacks; but, on the contrary, when the fuel is added carefully, at the front of the fire, in the manner before described, then much of the smoke given out by it is consumed in passing over the hot part of the fire.

Besides the management of the ash-pit register, the damper of the flue ought particularly to be attended to, by not opening it further than is absolutely necessary for the combustion of the fuel. The more the damper can be closed, provided that the fire will burn moderately well, the more heat will be retained in the flue, without escaping up the chimney, and the less fuel will be consumed. And, when the fire is made up for the last time in an evening, the damper should be put in as far as it can be, so as only to keep the fire just alive; and, in general, the fire may be allowed to burn bright, against the last attendance in an evening; and then, instead of putting on fresh fuel, close the ash-pit and damper completely. This will prevent any draught of cold air through the flues from carrying the heat out at the chimney; and the body of heat that is then in the mass of the brick-work of the flues, having no other means of escape than into the house, will frequently be found sufficient for the night.

The ash-pit register should be properly attended to, and never be suffered to get injured hy rust; not even in the summer time, when not in use. The door should then be taken off the hooks, and be properly cleaned, and be rubbed over with oil, to prevent it from becoming rusty.

The shovel, used for the fire-places, should have a short handle, which is quite as convenient for use as a long one; and with a short-handled shovel the fuel cannot be so easily thrown over the fire. The person who attends the fires

should be directed to use his hands in opening and shutting the doors by their proper handles, and not be suffered to do it with a spade or shovel; for, however strong they may be made, they may soon be destroyed by improper usage.

It is of the greatest importance to preserve the doors and ash-pits perfect; for, if they be injured, it is difficult to repair them without taking them out of the brick-work, which is attended with considerable expense, and cannot be done when the fires are in constant use.

Remarks by the EDITOR.

The above judicious observations are equally applicable to the fire places of furnaces for evaporation, &c.; and which ought always to be fitted up with double doors and ash-pit registers, as well as with dampers to their flues, agreeably to the excellent instructions furnished us by the late Count Rumford, in his various essays.

IX.—*On the advantages of a Steam Life-boat; and on extinguishing Fires by Steam-engines, &c. By Sir* WILLIAM HILLARY, *Bart.**

THE practicability of constructing a life boat, with properties applicable to particular situations, superior to any now in use, and of adopting means for the extinguishment of fire on board of vessels at sea, more especially steam vessels, had occurred to me previously to the publication of my "Appeal to the British Nation," which suggested the formation of the National Institution for the Preservation of Life from Shipwreck; but I was aware that such plans could better be carried into execution by public bodies or departments interested in maritime affairs, than by any individual.

The Royal National Institution is now established under the highest patronage of these kingdoms, and, through the

* From his "Plan for the construction of a Steam Life-Boat, and the Extinguishment of Fire at Sea."

able and zealous guidance of its committees, holds out the cheering hope that every means will be used to call into action the individual efforts and inventions of all who may have the power to render that personal assistance, or to suggest those means, through which our fellow creatures may be rescued from the perils of the sea; I therefore feel it to be as much a duty now to offer those separate and more minute measures which may contribute to the accomplishment of so great an object, as I before did to address my views of a universal system for this purpose to the public consideration.

I proceed, then, to state my ideas on the construction of a life boat upon a plan which, I believe, has not yet been suggested. *The principle I propose, is, to combine the safety and the incapability of being submerged, which the life boat possesses, with the commanding power of being impelled against both the wind and a heavy sea, which the steam vessel alone can effect to any great extent.*

In adapting the dimensions of the life boat to the force of the engine by which she is to be propelled, the important point will consist in ascertaining the smallest sized vessel calculated to receive an engine that, in proportion to her bulk, would have a commanding power over her, and at the same time, framed on the most perfect construction, would admit of being on a reduced scale: perhaps the boat might be about forty feet long, but varying in all her dimensions according to the nature of the service for which she may be intended; it would be both desirable and requisite that her beam should be considerable, and hence it would become nearly impossible for her to overset.

Her draught of water ought not to be great; her construction should be low, and such as that she might take the ground; her floor so completely filled with cork, as to be solid to a few inches above the water line, except only a small space to give more room for the machinery of the engine; consequently she would always be free from water in the roughest sea, and could not sink lower; but to guard

against the necessity of having to take in a large number of persons, let the sides also have an additional quantity of cork, greatly preferable to air-tight boxes, which are liable by a violent shock to be rendered useless at the moment when most important.

It would then, under any circumstances, be impossible for her to go down; she should be built of the best materials, and so put together as to sustain great violence without going to pieces—from her form she scarcely could be upset.

The engine should be formed to work within as small a perpendicular space as possible, fixed in a cabin for the purpose; and to prevent the fire in the furnace from being extinguished, it should be placed at least as high as the floor, that it may be above the water line: the rest of the vessel should either be open, half decked forward as far as the engine, or with a short forecastle. She should have valves or small ports, opening outwards only, that any sea she might ship would readily discharge itself; and being so constructed water could not force its way in;—she might have a windlass of a single piece of wood across, in the manner of the Irish wherries, with which to weigh her own anchor and to assist for other purposes, or so framed that the power of the steam engine might with ease be applied to it instead of manual labour. It would be desirable to have masts which might be raised or taken down at pleasure, perhaps as a lugger or schooner would be the most convenient; she ought also to be fitted with oars to be used when requisite.

Strong curved timbers should come round from the bows to the quarters, in which the outward axle of the water wheels should be fixed; they would defend the paddles when running alongside of a vessel in distress, or near to rocks, which protection would be of the utmost consequence to save them from injury at the time when every thing depended upon them.

Farther to add to her means of security, since steam

vessels are the most exposed to conflagration from their own intense fires, when tossed about in the roughest seas, I would suggest that she might, when thought advantageous, be fitted with forcing pumps or engines to throw water by her own steam power, on the plan I shall more generally describe; by these means she might also extinguish fire on board of other vessels.

The whole plan is simple and practicable, and I am persuaded would produce a life boat of the most invaluable description, which, from its strength and buoyancy, would scarcely be liable to accident in any sea, and which would be capable of reaching its destined object against the united force of winds and waves, when no other boat could succeed; thus possessing a power in all seas, and under all circumstances, that, I believe, never has been attempted, and certainly never attained by any other plan yet brought forward.

A steam life boat, possessing such powers and capabilities, would, on many dangerous and exposed parts of the British and Irish coasts, render the most essential services, and might occasionally be used as a pilot boat. I will instance off Liverpool, as one of the various situations to which she would be peculiarly applicable. Amongst the formidable banks which there lie some miles from land, and are covered at high water, wrecks frequently take place, and many people miserably perish, from the impossibility of a common life boat, pilot boat, or any other vessel, making way against a strong tide, a heavy sea, and a contrary wind, for several miles through those intricate channels, so as to render any aid; but I scarcely am aware of any circumstances of wind and tide against which a steam life boat of this description might not hope to succeed.

EXTINGUISHMENT OF FIRE.

Nearly allied to the calamity of shipwreck, not less sudden and tremendous in its nature, and often directly leading thereto from its results, may be regarded those

disasters arising from a vessel taking fire at sea. In such a moment of unexpected danger, left on the wide ocean to their own resources, and beyond the hope of receiving aid from any other quarter, it has too often happened that the crew have become so panic struck and bewildered, that the few important moments in which any means could have been effectually pursued to ensure their safety have been lost in confusion and despair.

In this, as in all other situations of extreme danger, the greatest safeguard will be found in that promptitude and coolness which can best be insured by forethought and previous arrangement to meet the calamity, however suddenly it may arrive; and which will be the most certainly accomplished, by being ever ready to convert those means which are always at hand, and those powers which are constantly within reach, through the most simple and direct process, into the immediate and effectual instruments of preservation.

Vessels of all descriptions, in various degrees, carry within themselves, as part of their ordinary equipment, means for the extinguishment of fire; and in their crews they possess the certainty to have them used in the most vigorous manner, by men stimulated through no less an inducement than the preservation of their own lives.

The general measure here proposed for vessels not worked by steam is to convert their pumps into powerful engines for throwing water for this important object.

The mode of working what are called chain pumps, on board of men of war down to the class of sloops, is particularly adapted to this purpose; in such cases, it would only be requisite to apply that machinery to a very small additional apparatus, not of the least inconvenience at any other time; perhaps a forcing pump and compression-ball, as used in fire engines, would be the most applicable, by which torrents of water might be thrown to any part of a ship, or several such pipes in play at the same time

would give a complete command of the hull, decks, and rigging of the largest vessel.

By these means, and a mode already in use on board of men of war, of stopping the scuppers and flooding the decks, it would scarcely be possible that any fire could get so much ahead as to become incapable of being soon extinguished.

In vessels of a smaller size any ingenious mechanic would, with ease and at a moderate expense, fix the apparatus to turn the pumps in general use into forcing pumps, by which sufficient water might be thrown to extinguish any ordinary fire.

The water required on all these occasions might either be admitted into the vessel through apertures for the purpose, or supplied over the side by pipes.

These principles apply generally, but steam vessels possess peculiar advantages, from having their impelling power without manual labour, and from the promptitude with which their enormous force could be brought to act on pumps and engines, which, with but little change, would answer the double purpose of overcoming almost any leak, or of throwing such a body of water, that they would instantaneously become deluged in every part. These vessels are of all others the most exposed to peril from conflagration, yet they carry within themselves the means by which a fire could not exist on board for ten minutes.

The furnace requisite for working the machinery being defended from the deluge thus suddenly caused, the decks might be flooded, the parts most exposed to the action of fire, by having channels leading to them, might be laid under water, and the rigging effectually protected, by incessant streams thrown upon it. The power of the steam engine would do the whole; it would only require three or four engineers or seamen, who might understand the process, to guide the pipes and direct the operations.

The means of applying the entire force of the engine, or to such an extent only as might be desirable, would be

simple, easy, and capable of being immediately accomplished by one man, who, with the aid of a lever, or by some other ready process, would only have to throw the machinery which was to work these forcing-pumps into contact with the steam engine, and the whole might be in full operation in five minutes after the fire was discovered.

The expense of fitting steam vessels in this manner would be small in comparison with the importance of the object, and would be fully repaid from the increased number of passengers they would be certain to receive, independent of the advantage they would derive from the reduction in the rate of insurance which would naturally follow on all vessels carrying within themselves this twofold means of preservation, from the danger of sinking from any leak which might take place, or of being destroyed by any fire to which their extremely combustible nature renders them liable.

The vast advantages which would result from this simple application of the engines of steam vessels to their own preservation, in situations of danger, are strikingly clear and incontrovertible. To define their great capabilities in aid of all the operations of naval warfare is impossible; but a steam vessel employed in connexion with men of war having, besides the power of being propelled against wind and tide, the great additional means not only of extinguishing any fire within herself, but also by being brought alongside of a ship which might be set on fire in action, of insuring the preservation of those to whose aid she was thus sent, is an extent of utility, the value of which scarcely can be estimated, but of which the most experienced naval commanders will be the best able to judge.

In the royal dock yards on the river Thames, and in various of the first ports of the kingdom, steam vessels fitted in this manner, or vessels expressly constructed for the purpose, having on board powerful steam engines, by which they could immediately be brought to the place

where they might be wanted, and at the same time having machinery of enormous power for throwing water in quantities far beyond what has ever yet been done, might render the most inportant services in the extinguishment of fire. Some delay, it is true, might at times take place before the furnaces could be heated; but afterwards, the overwhelming body of water would be capable of subduing the most violent conflagration.

The force of these engines would also enable them to propel water by pipes to a very considerable distance around, so as to render it scarcely possible that any fire which might break out amongst shipping, or buildings within their range, could be of long continuance; thereby arresting the progress of what might otherwise be of the most disastrous consequences.

These suggestions unquestionably include only a small part of that wonderful capability for maritime purposes which steam engines and steam vessels possess, and which a few years will certainly develop. Every discovery which, through the use of gas or other means, may prove a substitute for steam, and every improvement in steam engines which may increase the impelling power, or diminish the weight or quantity of the machinery, will greatly add to the facility of their adoption on board of large vessels, and extend their application down to those of the smallest class. At present the whole system, both in its general application and more minute parts, can only be regarded as in an infant state. It has been said that the power of the steam engine is equally available, from the boring of a cannon to the pointing of a needle—who then, after a moment's reflection, can avoid feeling surprise that hitherto these great powers have only been applied to the purpose of impelling vessels through the sea, whilst the most labourious duties on board are performed by the crew? It is sufficient to instance the great fatigue and loss of time in weighing the anchor in a strong tide and heavy sea, at the very moment the powers of the engine are lying dormant, and the surplus

steam let off in great quantities, when a capstan, fitted for the purpose, might immediately be brought to receive just so much power as was requisite; and this, and almost every other duty of that nature in the vessel, be promptly and effectually performed: thus producing an important reduction of the most severe manual labour.

These measures for the extinguishment of fire are alike available by land and by sea: the mode is as direct, the success as certain. Steam engines or water wheels, equally applicable to the same purpose, are the means through which the machinery of the most extensive and valuable of our manufactories are now impelled. From their very nature these buildings are most combustible, and are frequently consumed, whilst they have, as a part of their apparatus, the means which would ensure their immediate and effectual preservation, and that of every building within a considerable distance around them;—independent of the many lives which might thus be preserved, even the reduction of the premiums of insurance, as in the case of steam vessels, would far more than repay every attendant expense.

If this plan—the application of these powers to such purposes—is so clear and simple that even a child might have suggested it, and so palpable when once discovered, that we are only surprised it could lie dormant for a day; these considerations augment rather than detract from its value, because they evince that it is established on a foundation which cannot disappoint the hopes of those who place their confidence in it. The measure is one in which we cannot be deceived, it is self evident, and must carry a full conviction of its capabilities to every one in the slightest degree conversant with such subjects.

With these convictions, I should feel it a dereliction of duty were I any longer to delay in submitting my plans, on a subject in which the preservation of human life is deeply concerned, to the consideration of those departments of his majesty's government to which they more

peculiarly belong—to those gentlemen composing the committee of the Royal National Institution with whom I have the honour to act—and to the public at large, in order, if I am not mistaken in the ideas which I have formed of their utility and practicability, that they may thereby obtain every facility of being carried into effect.

X.—*On the singular method practised in the East Indies of rearing the seeds of the Carrot, Turnip, and Radish; to prevent the deterioration of those vegetables.* *By* WILLIAM INGLEDEW, *Esq.**

THE difficulty of preventing vegetables, particularly the European kinds, from becoming deteriorated in India, is well known to all gardeners who have had experience in that climate; seeds are, consequently, imported every year from England; and these, from various causes, often disappoint the horticulturists, being either decayed or dead on their arrival.

From this circumstance, I was induced to pay particular attention to a method of rearing the seeds of some vegetables, which I saw practised in the neighbourhood of Seringapatam, in the year 1806; from that year to 1818 I was much occupied in gardening, and therefore had ample opportunities of witnessing its efficacy; and if the practice of eleven years can authorize me to speak with confidence of its results, I need not hesitate to declare my belief, that vegetables on which this mode of operation can be performed, may be always preserved in their genuine and perfect state and quality.

The Indian gardeners in the Deckan confine the process I am about to describe to three different sorts of vegetables,—the carrot, the radish, and the turnip; these being in more constant demand among the native inhabitants than any other species grown in England: the following is the mode they adopt.

* From Vol. V. part V. of the Transactions of the London Horticultural Society.

They first prepare a compost, with equal proportions of buffalos' and swines' dung, as fresh as can be procured, and of red maiden earth, these are mixed well together into a smooth paste, with a sufficient quantity of water to make the whole of the consistence of tar; to a quantity of this mixture, equal to above five quarts, three drachms, by weight, of assa-fœtida, dissolved in a small quantity of water, are added. This compost is always used soon after it is prepared.

The vegetables for this operation, are drawn, when wanted, from the beds, when they have attained about one third of their natural growth; and those plants are chosen which are the most succulent and luxuriant, their tops are removed, leaving a few inches from their origin in the crown upwards, and a little of their inferior extremities, or tap-roots, is cut off likewise, allowing nearly the whole of the edible parts to remain; *from the bottoms of which, to within about an inch of their crowns, are made two incisions, across each other, entirely through the bodies of the vegetables; dividing them into quarters nearly to their upper ends.* They are then dipped into the compost, until they be well covered with it, both externally and internally; and are immediately placed in beds, previously prepared for their reception, at the distance of fifteen or sixteen inches from each other; and so deep in the ground, that the upper extremities only appear in sight. They are afterwards regularly watered, and when they take root and fresh tops have made some advance in growth, they require but little attention. The tops speedily become large, ard grow into strong and luxuriant stalks; the blossoms acquire a size larger than ordinary, and the seed they produce is likewise large and vigorous, and superabundant in quantity.

Innumerable roots are thrown out from the incised edges of these plants; they consequently receive a greater abundance of nourishment, which occasions their luxuriant growth, causes them to yield, not only a more than ordinary crop of seed, but also of superior quality.

The gardeners in the Mysore country, where I resided, consider the early part of January to be the most advisable time for putting these plants into the ground; the seed of the turnips will then be collected at the end of the third, and that of the carrots, at the conclusion of the fourth month afterwards. The weather throughout this period is generally dry in that part of India; the steady, dry, heat, which usually prevails there in March and April, matures and perfects the seed, which is formed previously to the appearance of such winged insects as infest and often impair the blossoms. If planted at other times of the year, when the weather is dubious, the effects of the compost are apt to be weakened or destroyed; and should heavy falls of rain happen soon afterwards, many of the plants will probably be destroyed; but if the weather be clear and favourable, they will, with a very few exceptions, survive and flourish.

The Indian gardeners consider red earth to be preferable to any other kind in the preparation of the above composition; and that of the white ant-hill, which is, I believe, invariably red, to be still superior. They believe the latter to be of a finer quality, and to have undergone some beneficial alteration in the formation of the hill, by the labour of these insects. They are of opinion that the other materials of the compost are equally requisite; being of a more heating nature than other manures, and that the *assa-fœtida* is beneficial in this respect, and gives additional force to the preparation.

It is not known how, or in what manner this process originated, or how long it has been in use at Seringapatam, where it has been employed from time immemorial; it is called the Hydrabad practice, which would induce the belief, that it may have been introduced from that city; but whether it be of Hindoo or Mahomedan origin cannot now, perhaps, be credibly ascertained. I should be inclined to favour the latter opinion.

In the years 1812 and 1813, I tried several experiments to ascertain the supposed superior power of buffalos' dung in the above compost; three several trials were made at intervals within this period, with two composts exactly similar, except that one contained its proportion of buffalos', the other a like quantity of cows' dung; the vegetables to which the former was applied germinated somewhat more speedily, and, for a time, had a more rapid growth; and some of these plants blossomed earlier than the others, but the size and strength of the full grown plants, the size of the blossoms and seed, and the quantity of the latter, appeared to be similar in every respect; and the vegetables which this seed afterwards afforded, were of equal quality.

Crops of vegetable seeds produced by the above process will not always be of similar worth; the seed collected from plants that have not, during the early period of their increase, and when in blossom, been exposed to heavy, or long continued rains; but, on the contrary, have experienced a steady heat, and mild weather, will, invariably, be superior to any other that may not have had these advantages. By this method, I was enabled to produce carrots and turnips of a superior quality, and uniformly of good flavour, for many years in India, without the introduction of foreign seed; which, otherwise, would have rendered frequent supplies of the latter necessary. Most vegetables deteriorate very rapidly in that climate, but none more so than the two sorts above mentioned.

I entertain no doubt of the superior merits of this method in rearing the seed of some vegetables in hot climates; but it is difficult to assert that the compost employed by the Indian gardeners is the best and most suitable that can be devised; or, whether the several ingredients with which it is prepared by them be particularly beneficial, or really necessary to success; it will, however, I think, be admitted, that a portion of some manure, if not required for nutrition, may be useful as a

stimulus; and also to soften the earth combined with it, and to render it easily pervious to the young and delicate roots that are about to be formed. A mixture of earth and water, merely, will, on drying, become hard; and instead of receiving with facility, may offer such resistance to the roots as may be detrimental to the plants.

It may likewise be of some consequence to select such earth for the compost as may contain much life and vigour; and if this supposition can be admitted, earth, that has not for a time been cultivated, will probably possess some superiority over such as has been partially exhausted by feeding plants. On this ground, the preference of the Indian gardener to the earth of the white ant-hill may deserve to be not entirely disregarded.

The nests of the white ants, in the south of India, are generally, if not always, found in a red soil, and at the depth of two or three feet below the surface of the ground. It is habitual with these insects to raise a perpendicular and conical mound of the earth immediately surrounding their habitations to the height of four, five, or six feet, according to the degree of moisture the ground contains, (for they cannot carry earth without moisture); they work this earth to an extraordinary degree of fineness, and deposit it in layers, until the work is completed.

It is probable that vegetables would die after undergoing the *severe operation* above described, if they were to be placed in the ground without any coating; but being well and closely covered, both externally and internally, with a substance that is probably congenial and nutritious to them, they are preserved from decay, and from the effects of bleeding at their wounded surfaces; and whenever roots are thrown out, they come into immediate contact with nourishment for their future support. It would appear to be requisite, therefore, that a covering of some sort should be employed; and that, whatever it may be, it should possess the quality of supplying food readily to the tender roots on their first appearance, to

preserve the plants alive; and which a garden bed, prepared in the ordinary way, the soil not pulverized, nor closely adhering to them, could not furnish so speedily.

The influence of the *assa-fœtida* employed by the Indian gardeners is probably over-rated by them; but it may, perhaps, be of service in repelling destructive insects for a time, until the delicate roots acquire sufficient size and strength to resist their attacks.

As I never knew beet-root to furnish seed in India, I subjected some of these plants, and some others likewise of the parsnip to this operation; but they failed of success.

XI.—*On Browning Gun-Barrels.*

In our second volume, p. 35, we gave an account of various methods of performing this process. In the ninth volume of the American Journal of Science and Arts, we find the following particulars, communicated to the Editor of that work by Mr. John Duntze, of New Haven, and which it may be desirable to add to our former account.

The Browning mixture.—This is composed of the following ingredients, viz.

Nitric acid	1 ounce.
Sweet spirits of nitre	1 do.
Spirit of wine	2 do.
Blue vitriol	4 do.
Tincture of steel	2 do.

These ingredients are to be mixed, the vitriol having been previously dissolved in a sufficient quantity of water to make, with the other ingredients, two quarts of the mixture.

Previously to commencing the operation of browning a gun-barrel, it is necessary that it be well cleaned from all greasiness and other impurities, and that a plug of wood be put into the muzzle, and the vent be well stopped up. The mixture is then to be applied with a clean sponge, or piece of rag, taking care that every part of the barrel be

covered with the mixture; it must then be exposed to the air for twenty-four hours, after which the barrel must be rubbed with a hard brush, to remove the oxide from the surface.

This operation must be performed a second, and, if necessary, even a third time; by which the barrel will be made of a perfectly brown colour. It must then be carefully brushed and wiped, and immersed in boiling water, in which a quantity of alkaline matter has been put, in order that the farther action of the acids upon the barrel may be prevented, and the impregnation of the water by the acids be neutralized.

The barrel being taken out of the water, must, when rendered perfectly dry, be rubbed smooth, with a burnisher made of hard-wood: it must then be heated to about the temperature of boiling water; and will then be ready to receive a coating of a defensive *varnish*, made of the following materials.

Spirit of wine, one quart
Dragon's blood, (*sanguis draconis*,) pulverized, three drachms,
Shell-lac, bruised, one ounce;

mixed and dissolved by a gentle heat, and then strained for use.

After the varnish is become perfectly dry upon the barrel, it must be rubbed with the burnisher, to give it a smooth and glossy appearance.

Thus far the American account. We think it proper to add, that the use of sulphate of *iron*, (green vitriol), has become frequent amongst the London gun-makers, as well as that of the sulphate of copper, for producing *a prominent veining* on the surfaces of the barrels; and which is now become desirable, in imitation of the Damascus barrels.

XII.—*On the Mineral History of Gold, and on the separation of it from Earthy and Stony bodies by water, Mercury, &c. By the late* WILLIAM LEWIS, M. D.

WE have, in the commencement of our present volume, given an interesting article, "On the Gold Mines of North Carolina," by Professor Olmsted, from the "American Journal of Science and Arts." We think it desirable to add the following valuable collection of facts on the mineral history of gold, and on extracting it from the earths, &c. with which it is naturally mixed, contained in the late celebrated Dr. William Lewis's "*Commercium Philosophico-Technicum*, or Philosophical Commerce of Arts;" and particularly as the public attention is now so much directed to the gold mines of South America.

The mineral history of Gold.

Gold is found in its perfect metallic state, sometimes in masses of considerable magnitude, more frequently in dust or minute grains, intermingled among earths and sands, or in little drops and veins, bedded in different coloured stones, which strike fire with steel, and are not soluble in aqua-fortis. It is never debased into a true ore, as other metals generally are, by the coalition of arsenical or sulphureous bodies; though it is often very intimately combined in the composition of sands and stones, and blended in small proportion, with the ores of other metals. It is scarcely ever free from some admixture of other metals, particularly of silver. Cramer observes, that such as is found loose in earths and sands, generally contains more silver than what is lodged in a solid matrix. To such an admixture is apparently owing the paleness of some kinds of gold; and probably the Malaccasscan gold, said by Flacourt in his history of Madagascar, to be not only paler, but much more fusible than that of Europe, and which has hence been supposed by some to be in its own nature distinct, is no other than a mixture of gold with a certain quantity of silver: it is said to be of consi-

derably less value than the European gold, from which circumstance, (omitted by Boyle and others, who have quoted Flacourt's account), it may be presumed that it is not regarded upon the spot as being pure gold.

The Brazils, the Spanish West Indies, some parts of the East Indies, and the coast of Africa, afford the largest quantities of gold. Some parts of Europe, also, appear to be rich in this metal: the mines of the Upper Hungary, which seem to be the most considerable in this quarter of the world, have continued to yield gold for upwards of ten centuries.

Peru, Mexico, Chili, and other provinces of the Spanish West Indies, abound with gold, in a variety of forms. It is found both in the sands of rivers, and in mines; intermixed with loose earth, lodged in fissures of rocks, and bedded in hard stones; at the surface of the earth, and at great depths; in dust, in grains, like the seeds of apples, called *pepitas*, and sometimes in considerable masses of an extraordinary size. Reaumur reports, that a piece was shown to the French academy, which was said to weigh fifty-six marcs, or four hundred and forty-eight ounces; and Feuillée says he saw one in the cabinet of Antonio Portocarero, which weighed upwards of sixty-six marcs, or five hundred and twenty-eight ounces. Both these pieces were assayed, and found to be of different fineness, in different parts of the mass; the first was, in one part, twenty-three carats and a half; in another, twenty-three; and in another, only twenty-two: the second was, in one part, twenty-two carats; in another, twenty-one; and in another, but seventeen and a half. It is, however, rare to meet with masses, of the weight even of an ounce; the largest in the Briti h Museum weighs but fifteen penny-weights. Notwithstanding the extensive dissemination of it through those provinces, yet the quantity of the gold, in proportion to the earthy and stony matter mixed with it, appears to be in general exceeding small. According to Frezier, in his voyage to

the South Sea, and Captain Bretaghs's account, printed in Harris's collection, the common yield is no more than five or six ounces of gold, upon the caxon, or fifty hundred pounds of the mineral: the richest mines afford only ten or twelve ounces; and those which are but just rich enough to pay the charges of working them, yield only two ounces on that quantity. It may be observed, in general, that the quantity of gold in minerals is more variable than that of other metals in their ores, and the profits of a gold mine more precarious; this metal not being formed in any regular veins, or uniformly distributed through any particular kind of earth or stone, but scattered, as it were, here and there, through different mineral bodies: when united with other metals in their ores, its proportion is by no means constant; though, in this case, it is subject to much less variation than when it is barely bedded in earths or stones.

Of the source of the gold in the East Indies and of Africa, we know but little. From Cape Coast, on the coast of Africa, we receive yearly between two and three thousand ounces of gold dust, which is supposed to be collected from the sands of rivers; and some European traders are said to have been witnesses of the richness of the sands in certain parts of that coast. In Hooke's posthumous papers, an account is given of a person having met with great quantities of gold, in the sands of one of the rivers; the sand seeming to grow richer and richer as he advanced further up: in some places, he says, he gained sixty-three grains of gold from five pounds of sand; and he seems, afterwards, to have met with much more profitable spots. Three or four hundred ounces, as I am informed, are collected yearly from the sands of the Gambia, and cast into bars at James Fort, one of our settlements on that river.

It is said, that the gold dust from Africa, in its purest state, is from twenty one to upwards of twenty-two carats fine; but that the natives frequently mix with it filings of brass. This admixture may be distinguished by the hy-

drostatic balance, the specific gravity of brass not being half so great as that of the gold dust: in this way of examination great care must be taken to make the water penetrate as perfectly as possible into all the interstices, so as to come into close contact with every particle. A little aqua fortis also, poured on the mixture, will immediately discover the fraud, receiving from the copper in the brass a blue tinge. It has been suspected, that if the gold be naturally alloyed with a little copper this trial will prove fallacious, and that the natual copper will tinge the menstruum equally with that which is added by art: of this, however, there is no danger, the natural alloy not being in distinct particles, but diffused through each mass or particle of the gold, so as to be covered by the gold, and protected from the action of the menstruum. There are several other means by which this abuse may be discovered: if the dust be spread thin on a piece of white paper, and moistened with any volatile alkaline spirit, as that of hartshorn, of sal-ammoniac, or of wine, the spirit will, in a few minutes, dissolve so much of the copper as to stain the paper blue: stale urine itself has a like effect in an inferior degree; and a solution of crude sal-ammoniac, applied in the same manner, produces a greenish stain.

[*To be continued.*]

LIST OF PATENTS FOR NEW INVENTIONS,

which have passed the Great Seal since May 31, 1825.

To William Henry James, of Cobourg-place, Winson Green, near Birmingham, engineer; for certain improvements in apparatus for diving under water; and which apparatus, or parts of which apparatus, are also applicable to other purposes. Dated May 31, 1825.—To be specified in six months.

To John Harvey Sadler, of Hoxton, in the county of Middlesex, machinist; for an improved power-loom for the weaving of silk, cotton, linen, wool, flax, and hemp,

and mixtures thereof. Dated May 31, 1825.—In six months.

To Joseph Frederick Ledsam, merchant, and Benjamin Cook, brass-founder, both of Birmingham; for improvements in the production and purification of coal gas. Dated May 31, 1825.—In six months.

To Joseph Crowder, of New Radford, in the county of Nottingham, lace net manufacturer; for certain improvements in the power bobbin-net machine. Dated May 31, 1825.—In six months.

To Joseph Apsdin, of Leeds, in the county of York, bricklayer; for a method of making lime. Dated June 7, 1825.—In two months.

To Charles Powell, of Rockfield, in the county of Monmouth, gentleman; for an improved blowing machine. Dated June 6, 1825.—In six months.

To Alfred Bernou, of Leicester-square, in the county of Middlesex, merchant, in consequence of a communication made to him by a certain foreigner residing abroad, for certain improvements in fulling mills, or machinery for fulling and washing woollen cloths, or such other fabrics as may require the process of fulling. Dated June 7, 1825.—In six months.

To Moses Poole, of the Patent Office, Lincoln's Inn, in the county of Middlesex, gentleman, in consequence of a communication made to him by a certain foreigner residing abroad, for the preparation of certain substances for making candles, including a wick peculiarly constructed for that purpose. Dated June 9, 1825.—In six months.

To John Burridge, of Nelson-square, Blackfriars-road, in the county of Surrey, merchant; for certain improvements in bricks, houses, or materials for the better ventilation of houses, and other buildings. Dated June 9, 1825.—In six months.

To John Lindsay, of the island of Herne, near Guernsey, esquire; for certain improvements in the construction of the horse and carriage ways of streets, turnpike and

other roads, and an improvement or addition to wheels to be used thereon. Dated June 14, 1825.—In six months.

To William Henry James, of Cobourg-place, Winson Green, near Birmingham, in the county of Warwick, engineer; for certain improvements in the construction of boilers for steam engines. Dated June 14, 1825.—In six months.

To Jonathan Downton, of Blackwall, in the county of Middlesex, shipwright; for certain improvements in water closets. Dated June 18, 1825.—In six months.

To William Mason, of Castle-street East, Oxford-street, in the parish of Saint Marylebone, in the county of Middlesex, axletree manufacturer; for certain improvements on axletrees. Dated June 18, 1825.—In six months.

To Charles Phillips, of Upnor, in the parish of Findsbury, in the county of Kent, esquire; for a certain improvement or improvements in the construction of a ship's compass. Dated June 18, 1825.—In six months.

To George Atkins, of Drury-lane, in the parish of Saint Clements Danes, and county of Middlesex, gentleman; and Henry Marriott, of Fleet-street, in the city of London, ironmonger; for certain improvements on and additions to stoves or grates. Dated June 18, 1825.—In six months.

To Edward Jordan, of the city of Norwich, engineer; for a new mode of obtaining power applicable to machinery of different descriptions. Dated June 18, 1825.—In six months.

To John Thompson, of Vincent-square, Westminster, and the London Steel Works, Thames Bank, Chelsea; and John Burr, of Halesowen, near Birmingham, engineer; for certain improvements in producing steam, applicable to steam engines or other purposes. Dated June 21, 1825.—In six months.

To Thomas Worthington, the younger, and John Mullerier, both of Manchester, in the county of Lancaster, small-ware manufacturers; for improvements in the loom or machine used for the purpose of weaving or manufac-

turing of tape, and such other articles to which the said loom or machine may be applicable. Dated June 21, 1825.—In six months.

To Ross Corbett, of Glasgow, in Scotland, merchant; for a new step or steps to ascend and descend from coaches and other carriages. Dated June 21, 1825.—In six months.

To Phillip Brookes, of Shelton, in the Potteries, Staffordshire, engraver; for an improvement in the preparation of a certain composition, and the application thereof to the making of dies, moulds, or matrices, smooth surfaces, and various other useful articles. Dated June 21, 1825.—In six months.

To John Frederick Smith, of Dunston-hall, Chesterfield, in the county of Derby, esquire; for certain improvements in machinery for drawing, roving, spinning, and doubling cotton wool and other fibrous substances. Dated June 21, 1825.—In six months.

TO THE PUBLIC.

WE feel it incumbent upon us to explain to our readers the motives which have induced us to give a new form to some of the Numbers constituting the present Volume.

The fact is, that finding the laudable desire of diffusing knowledge amongst our *operative mechanics* and *artizans* so universally prevailing, we thought it our duty likewise to render the *valuable practical information* contained in the TECHNICAL REPOSITORY more readily accessible to them; and, therefore, we have now so arranged the publication of it, that, whilst we still continue the monthly supply, we can also divide each Monthly Number into Two Parts; so that now one may be had either every fortnight regularly, or when it may suit the convenience of purchasers.

The prices of both series are also reduced; as, in order to render them conveniently divisible, we found it necessary to abstract half a sheet of the usual contents of each Monthly Number.

We trust, from these new arrangements, that whilst our monthly sale amongst the higher classes of society will continue to increase, we shall also find a greatly increased sale indeed amongst those numerous and valuable classes of society, the Operative Mechanics and Artizans. And the public may be assured, that it shall be our constant endeavour to render our work still more deserving of its encouragement and support.

THE

TECHNICAL REPOSITORY.

XIII.—*On Screw-stocks, Dies, Taps, Screw-plates, &c.* *By the* EDITOR.

[*Continued from page* 37.]

WITH A PLATE.

IT having been suggested to us, that the screw-stock and dies, described at page 34, excellent as they confessedly are, may yet be thought by many persons to be unnecessarily complicated for ordinary purposes; and as we earnestly wish to bring the facile methods of constructing them in their simplest state into general use, possessed, as they undoubtedly are, even in those simpler forms, of great and manifest advantages over the stocks and dies in common use; so we now give a complete detail of the construction of the watch-makers' screw-stock and dies, mentioned in that article; and from which detail no possible difficulty can now occur in making them.

In plate III. fig. 1 is a front view, and fig. 2 a side view of this screw-stock, with one die and wedge in it; the other die and wedge being removed, in order to show the forms of the different parts more distinctly.

The basis of this screw-stock, like the former one, consists of a flat brass, gun-metal, or iron frame, A A, with a long aperture, B, made through it, the sides of which are parallel, and at right-angles to the plane of the face of the stock. A flat plate of steel, iron, or brass, C C, fig. 2, is also rivetted firmly to its underside, with an aperture, D, in it, as in the former stock; its inner sides or edges, E E, fig. 1, also projecting inwardly, for the dies to lodge upon, —(this is shown distinctly in the section of the stock, fig. 3, which is taken at the dotted line F G, in fig. 1); it is also

furnished with two tapering dove-tailed steel wedges, H and I, sliding across its upper face, and which are lodged in the dove-tailed grooves at J J and K K, made in the sides of the frame to receive them. The screw, L, with its octangular head, M, completes the screw-stock, and which will certainly be allowed to be capable of being readily constructed; it indeed requiring nothing more than the ordinary truth of workmanship. The making and fitting of the dies, N and O, into the stock will also be found equally facile, they being merely blocks of cast steel, with square sides and ends, and a gap, P, made across the middle of each, for the wedges to act upon. The die, O, is shown in front at fig. 4; edgeways, in fig. 5; and in section, at the dotted line, Q R, in fig. 4, in fig. 6. One of the wedges, I, is shown separately in fig. 7, and in section at fig. 8; the other wedge, H, being in its place in the stock, figs. 1 and 2. These wedges, by their tapering form, are admirably adapted to their use; for, as they are driven, they burrow more and more under the shelving sides of the dove-tailed grooves, J and K; and the consequent effect of that burrowing, is to cause them to press upon the dies, and secure them more firmly in their places in the stock. The indentations for cutting screws in these dies are made across their ends, as usual, and as seen in fig. 9: there is, however, only one notch or gap made in the middle of each indentation of them, which is a very common method, though, perhaps, not equal in effect to the three gaps, shown in our former plate, when judiciously made. A small block of metal, S, fig. 10, is necessary also in this stock, to prevent the nose of the screw from injuring the screwed indentation upon the opposite end of the die, and which block must have a cavity made in it for the end of the screw to lodge in, and prevent the block from falling out of the stock.

Some difficulty in fitting the wedges into the dove-tailed grooves of the stock may, possibly, present itself to the minds of those not accustomed to make it. This difficulty, however, is soon overcome by first hardening and temper-

ing the wedges; and then, after shaping the grooves as nearly as may be to their proper forms, by filing them, driving in the wedges, which will, of their own accord, accurately form the grooves, so as to fit them. Each wedge should be marked, as well as its corresponding grooves; as it is not at all necessary that it should fit the others likewise.

A reference to our former article on screw-stocks and dies, may afford a still farther elucidation on this subject, whilst these additional particulars will render the description of the screw-stock and dies, before given, still more intelligible.

On finishing Dies for cutting Screws.

There are various ways of finishing the dies for cutting screws in stocks: the most common is that shown in figs. 1 and 4, each die having only one notch or gap made in the middle of it, and the ends of the dies are ground perfectly flat.

Another and a preferable mode is shown on a larger scale at fig. 11. Here, besides the gap above described, two others are made in each die; one on each side of the former. These dies are shown as beginning to cut a cylinder into a screw, and which cylinder is equal in diameter to the tops of the threads of the intended screw. It will be seen that but a small portion of a circle is allowed to the cutting part of each die, but which is preferable to employing a greater part of the circle; and that all the four corners, *a a a a*, are in contact with the cylinder at once, and ready to act upon it. The interior dotted circular line, shown in the section of the cylinder, represents the bottoms of the threads of the intended screw, and the same is evident in the hollows made by the original tap in the screwed ends of the dies; the angular gaps, *a a a a*, being filed across to the exterior portions of circles, forming the tops of the threads in the screws cut by the dies.

These observations, of course, apply to the case when one pair of dies only are made to begin and finish the

screws: we have, however, before mentioned the late Mr. James Allan's and Mr. Clement's excellent methods of employing dies of different sizes to begin and finish the screws*: but these form exceptions of by no means frequent recurrence.

We have seen a numerous set of dies for cutting screws in stocks, which formerly belonged to an excellent workman in the mathematical instrument making line, and which had a still smaller portion of the circle in each, and had no gaps or notches at all made across them. Nevertheless, these dies made excellent screws; and, notwithstanding the *obtuseness* of the angles at *b b*, in fig. 12, which represents this part of one of the dies, they actually *cut* screws in hard wood, as was manifested by the quantity of dust formed by their action. We had previously conceived that they merely *squeezed* the wood or metal into the form of screws, and did not cut them, as was proved by the experiment.

We shall have occasion, in the continuation of this article, to again recur to various other forms given to the dies.

Of the proper Forms for Screw-taps.

Variety of conflicting opinions on the best forms of screw-taps prevail; we shall, however, describe one which, after a most extensive enquiry amongst some of our best workmen, appears to possess every desirable requisite.

It is usual to give *four* flat sides to screw-taps; but when it is known that only *three* points of bearing can generally be had, the choice of *three* sides only will undoubtedly claim the preference, and is, indeed, now universally adopted amongst some of our principal mechanists.

All taps ought to be originally made *cylindrical*, not *tapering*, (except by their secondary flat sides, as will be explained presently); three principal flat sides should be made, forming tangents to, and parallel to its cylinder and axis; and three secondary ones, tapering away from

* See Vol. VII., pp. 298 and 299.

the tops to the bottoms of the threads of the screw, as is shown in fig. 13. These secondary sides should not, however, form tangents to the circle, but be made in the positions shown at *c c c*, in fig. 14: that is, have three cutting edges made upon them; and if they were also hollowed or undercut a little, as shown by the dotted lines in that figure, they would be still better, and the taps would then not be liable to clog up from the cut particles lodging in the female-screw or tap whilst cutting. Another advantage likewise arises from these three cutting edges, namely, that of their again forming only *three* points of bearing, as before recommended.

Small taps may also have their points made angular, as shown in fig. 15, so that they may serve to bore or open the hole to be tapped, to the exact size.

On improved Screw-plates.

Screw-plates cannot possess all the advantages of the dies in stocks, in performing the work of cutting screws by degrees, as the dies are brought nearer to each other; nevertheless, they are susceptible of receiving considerable improvements: one of these we shall describe. Fig. 16 is a screw-plate, having three holes in it all tapped alike; the hole *d* is, however, afterwards widened with a taper broach, and so also is the hole *e*; the third hole, *f*, remaining as left by the tap. The effect of this contrivance is, that the first hole, *d*, only partially cuts the thread of the screw, the second, *e*, cuts it deeper, and the third, *f*, finally completes it. The two first holes have a slit made between them, in order to admit a saw, to cut out any screw which may happen to break in either of the holes. There is, besides, a gap, *g*, made in the end of the plate, to serve as a gauge for the cylinder to be cut into a screw by the plate.

The Editor invented this screw-plate several years since, and thought that he was the sole possessor of it. Lately, however, he has seen such in the hands of Mr. Thomas

Peek, an engineer, in Clerkenwell. This furnishes an additional proof that whoever think right will generally think alike.

[*To be continued.*]

XIV.—*On the Twin, or Double Steam-boats, employed in the Ferry across the River Tay, at Dundee. By Captain* BASIL HALL, R. N. F. R. S. L. *and* E.*

THE distance from Dundee to Newport, in a straight line, is one statute mile and a little more than a half, or very nearly 2,760 yards. At certain times of tide, the passage cannot be made directly across, owing to the mud banks which lie nearly in the middle of the stream; so that the average distance of the passage, allowance being made for the set of the tide, may be stated at about two miles and a third. This passage is made by the twin-boat in seventeen minutes, at an average, in neap tides; and in twenty-three at spring tides. In very blowing weather, it sometimes takes from thirty to fifty minutes, and once it took an hour. During 1824, the passage was never interrupted for one whole day; and it was only five times detained throughout the whole year, owing to hard westerly gales during the ebb tide.

There are two steam boats belonging to the ferry, one of which is employed at a time, except in harvest, when the reapers come down, or at the season when numerous droves of cattle come from the north. On these occasions, both are put in requisition, though not absolutely necessary, in order to avoid the possibility of delay. In order still farther to meet the public convenience, a pinnace with four able seamen is stationed at each end of the ferry, for the purpose of affording a passage to travellers who are unwilling to wait the periodical sailing of the steam-boat.

These boats are also in attendance during the night, when the steam-boat has ceased to ply.

As the twin-boat is very little known as yet in this

* From the Edinburgh Quarterly Philosophical Journal, No. XXV.

country, an account of one may possibly prove interesting, if not useful to some readers. There are some material differences between the two boats at Dundee, but that last built being the most perfect of the two, a description of her will be the most satisfactory.

She is called the George the Fourth: is 90 feet long over all, and 29 broad; she has 6 feet 8 inches depth of hold; and draws, when light, 4½ feet of water,—and when loaded, rarely more than 5 feet 4 inches. She is of the double kind of steam-boat, with a single paddle-wheel, working in the middle, between two divisions, or separate smaller boats, placed parallel to one another, at the distance of 8 feet apart. Over these two divisions, are placed horizontal beams, covered by a deck, the planks of which, instead of being placed fore and aft, in the usual way, cross the vessel from side to side, and thereby contribute greatly to the strength of the whole. To a person standing on the deck, she appears to be but one vessel. At each end there is a space railed off for cattle, one 33 feet by 27½, the other 27½ by 21. From 80 to 90 head of cattle is her average load; but, upon one occasion in fine weather, she actually carried 103 cattle, and 3 horses. In the middle part of the deck, between the spaces alloted for cattle and carriages, there is ample space for foot passengers, for whom also, in rainy weather, there are two commodious cabins. The machinery of the two steam-engines (each of 20 horse power) is concealed below; but the paddle-wheel being 14 feet in diameter, necessarily rises considerably above the deck, where it is covered by a wooden case.

This wheel is seven feet wide, and is immersed 18 inches in the water. It is a matter of perfect indifference which end of the boat goes foremost, both being alike in all respects. As the method of fixing the rudders, one of which is fixed at each end, is, of course, different from that of a ship, it may be useful to describe it particularly. The rudder is a plate of iron 4½ feet long, and 3 feet deep. It is fastened to a vertical spindle, reaching from the middle of

the stern to the water. In the first boat employed in the Tay, the rudder was attached by one end to the spindle, so that, when she was in motion, its whole length trailed behind. But this rudder being found difficult to move, a device was adopted which answers the purpose perfectly. The spindle, instead of joining the rudder at the end, is fixed to it at one-third of the length; so that when the vessel is in motion, two-thirds are abaft, and one-third before the spindle, resembling a large weather-cock, or vane inverted. A horizontal wheel is fixed to the upper extremity of the spindle, and this is turned by a wheel and pinion by the steersman. Both the divisions composing each twin-boat are flat-bottomed, have perpendicular sides, and are sharp-bowed; the angle at which the two bows meet at the extremities being 60°, ample room is allowed for the escape of the back-water. The rudder is placed in the middle point between the two stems; and, of course, lies directly in the centre of the current of back-water thrown out by the paddle-wheel. The steersman stands on a raised platform, above the taffrail, from whence he commands a clear view over the paddle-case. There are no masts; and the only resistance which is offered to the wind is from the chimneys of the engines.

Though the manner in which the two engines of a steam-boat are made to act in concert be known to every person at all acquainted with the subject, it may perhaps interest some readers to describe, in a popular way, the beautiful device by which this object is accomplished. The paddle-wheel is moved by one continuous shaft, to which both engines give their impulse, by means of two cranks, or bends in it, formed so as to be at right angles to each other. Thus when one of the cranks is either quite up, or quite down, and consequently the power of the engine connected with it, for the moment, entirely gone, the other crank must be in a horizontal position, and the power of its engine will be, for the same moment, at a maximum. The result therefore is, that, precisely in proportion as one en-

gine loses power, the other gains it; and, consequently, the united effect of the two against the resistance, at every instant of their action, is virtually equal to the constant power of one of them at its greatest; so that, whether the engine be moving fast or slow, or the resistance great or small, the same uniform force is exerted.

At each of the landing-places, there have been built low-water piers; along the sides, or across the ends of which, the steam-boat can be placed at any time of the tide, and during all weathers; so that passengers and cattle are embarked with as much ease as if they were going along a bridge; while carriages and carts drive in on one side of the river and out again on the other, without removing the horses. The utmost attention is paid to the hours of departure. Three minutes before the town clock of Dundee strikes the hour, a bell is rung on board the boat; and the instant the hour is told, the paddle-wheel begins to move, and the vessel to glide from the pier. In like manner, when the half hour strikes at Newport, she quits the opposite pier; and so on from sunrise to sunset; her crossings and recrossings never being interrupted. To ensure the constancy of this essential, but very difficult point, an able and active superintendant has been appointed, with a handsome salary, and a house on the spot: his exclusive business is to arrange the whole details of the passage, and to prevent all unnecessary delays. A collector is also appointed, a gentlemen who, in like manner, resides constantly on the spot, and attends exclusively to the money department. In consequence of the vigilance of these two officers, acting under the judicious regulations which the trustees have from time to time established, it is most worthy of remark, that, however great the crowd of cattle, carriages, or passengers may be, not the least delay or confusion ever arises, either at the embarkation or re-landing.

On board the boat the system is equally perfect: there is a coxswain, an engineer, five seamen and a fireman.

Long practice has given to those people so exact a knowledge of the power which is in their hands, that this huge and apparently unwieldy boat, is moved about with a celerity and precision altogether astonishing. To a stranger, however much accustomed he may have been to the wonders of machinery elsewhere, the effect is truly magical. The steam-boat, or, more properly, this great double raft, is discovered advancing at the rate of seven or eight miles an hour, directly for the shore, threading her way like a little skiff amongst the vessels lying in her way. In a few seconds she arrives, still at full speed, close to the shore. In the next instant she is arrested, by a touch of the engineer's hand, as suddenly as if she had struck upon a rock; and is placed, by the sole instrumentality of her invisible machinery, close by the side of the pier, with as much accuracy as if she were in a dock, and as much gentleness as if, instead of being made of stout oak and iron, she were formed of glass. In a moment, two great folding gangways are lowered down, and her side being thus thrown open cattle, horses, passengers, all walk out, and find themselves on land, with scarcely any circumstance having occurred to indicate they had been on the water.

Whatever might have been the degree of public spirit and activity of the trustees, it was not possible that so extensive and perfect an establishment as this could have been completed without a very considerable expense. Yet those who are most familiar with public works of this description, will readily understand, that pecuniary difficulties were not likely to have been the most serious ones in the way of its attainment. But it were an invidious task to speak of the irksome opposition occasionally raised in the way of the patriotic and disinterested endeavours of the trustees, whose final, and complete, and now universally acknowledged success, is the best, and certainly the most dignified answer to all such gone-by hostility, from whatever motive it originated. The public gratitude, which, for once, is both loud and steady in its acknowledgements,

is an ample reward for labours which are sufficiently proved by the result, to have been directed solely to the general good.

The heaviest expense into which the trust has been led, is for erecting low-water piers on both sides of the Tay. That on the Dundee side is 429 feet long, by 30 feet wide of carriage way, exclusive of a 4 feet raised path for foot-passengers. The pier at Newport is 350 feet long and 60 feet wide, with a carriage-way on each side. A depth of 6 feet water is obtained by means of these piers, at dead-low water spring-tides. The cost of the two, when completed, will be about £17,000. These works, designed by Mr. Telford, and executed by Mr. Logan of Dundee, are most perfect and beautiful of their kind.

The next important expense has been the purchase of the two twin-boats.

The Union, which was built in 1821, cost	£4245 8 6
The George IV. built in 1823, cost . .	4330 14 10
Making for both, . .	£8576 3 4

Both these boats were built by Mr. James Brown, ship-builder at Perth, in conjunction with Messrs. James and Charles Carmichael, engine-makers at Dundee, who furnished the whole of the machinery. The first boat, from a natural apprehension of the weakness of the principle, was made unnecessarily strong; and, consequently, from the quantity of materials, drew more water than she need have done. This defect was remedied in the second boat.—Many other important improvements on the second boat were also suggested by the previous experience. It is almost needless to point out to persons interested in other ferries, who may have thoughts of trying a similar experiment, how much advantage they will have in consulting workmen, who, independently of a very high character for skill and diligence in the ordinary line of their business, now add the material qualification of successful experience in a walk hitherto untrodden.

XV.—*On a very sensible Balance, for weighing small Globules of Metals. By the late Dr.* BLACK*.

DEAR SIR, *Edinburgh, Sept.* 18, 1790.

I HAD the pleasure to receive your letter of the 9th. The apparatus I use for weighing small globules of metals, or the like, is as follows: a thin piece of fir wood not thicker than a shilling, and a foot long, 3-10ths of an inch broad in the middle, and 1½-10ths at each end, is divided by transverse lines into 20 parts; that is, 10 parts on each side of the middle. These are the principal divisions, and each of them is subdivided into halves and quarters. Across the middle is fixed one of the smallest needles I could procure, to serve as an axis, and it is fixed in its place by means of a little sealing wax. The numeration of the divisions is from the middle to each end of the beam. The fulcrum is a bit of plate brass, the middle of which lies flat on my table when I use the balance, and the two ends are bent up to a right angle so as to stand upright. These two ends are ground at the same time on a flat hone, that the extreme surfaces of them may be in the same plane; and their distance is such that the needle when laid across them rests on them at a small distance from the sides of the beam. They rise above the surface of the table only one and a half or two-tenths of an inch, so that the beam is very limited in its play.

The weights I use are one globule of gold, which weighs one grain; and two or three others which weigh one-tenth of a grain each; and also a number of small rings of fine brass wire made in the manner first mentioned by Dr. Lewis, by appending a weight to the wire, and coiling it with the tension of that weight round a thicker brass wire in a close spiral, after which the extremity of the spiral being tied hard with waxed thread, I put the covered wire in a vice, and applying a sharp knife which is struck with

* Described in a letter from him to James Smithson, Esq. Annals of Philosophy, new series, No. LV.

a hammer, I cut through a great number of the coils at one stroke, and find them as exactly equal to one another as can be desired. Those I use happen to be the 1-30th part of a grain each, or 300 of them weigh 10 grains; but I have others much lighter.

You will perceive that by means of these weights placed on different parts of the beam, I can learn the weight of any little mass from one grain or a little more to the $\frac{1}{1200}$ of a grain. For if the thing to be weighed weighs one grain, it will, when placed on one extremity of the beam, counterpoise the large gold weight at the other extremity. If it weighs half a grain, it will counterpoise the heavy gold weight placed at 5. If it weigh 6-10ths of a grain, you must place the heavy gold weight at 5, and one of the lighter ones at the extremity to counterpoise it; and if it weighs only 1, or 2, or 3, or 4-100ths of a grain, it will be counterpoised by one of the small gold weights placed at the first, or second, or third, or fourth division. If on the contrary it weigh one grain and a fraction, it will be counterpoised by the heavy gold weight at the extremity, and one or more of the lighter ones placed in some other part of the beam.

This beam has served me hitherto for every purpose: but had I occasion for a more delicate one, I could make it easily by taking a much thinner and lighter slip of wood, and grinding the needle to give it an edge. It would also be easy to make it carry small scales of paper for particular purposes.

We have no chemical news. I am employed in examining the Iceland waters, but have been often interrupted. I never heard before of the quartz-like crystals of barytes aerata, nor of the sand and new earth from New Holland. Indistinct reports of new metals have reached us, but no particulars. Some further account of these things from you will, therefore, be very agreeable. Dr. Hutton joins me in compliments, and wishing you all good things; and I am, dear sir, &c. &c. &c. JOSEPH BLACK.

Note by Mr. Smithson.—The rings mentioned above have the defect of their weight being entirely accidental; and consequentaly most times very inconvenient fractions of the grain. I have found that a preferable method is to ascertain the weight of a certain length of wire, and then take the length of it which corresponds to the weight wanted. If fine wire is employed, a set of small weights may be thus made with great accuracy and ease. Inconvenience from the length of the wire in the higher weights is obviated by rolling it round a cylindrical body to a ring, and twisting this to a cord.

This little balance is a very valuable addition to the blowpipe apparatus, as it enables the determination of quantities in the experiments with that instrument, which was an unhoped-for accession to its powers.

Dr. Black mentioned to me its having been used by an assayer in Cornwall, to whom he had made it known; and I have since heard, from another person, of an assayer in that county, who, finding the assays he was employed to make, cost him more in fuel than he was paid for them, had contrived means of making them at the blowpipe on one grain of matter. I presume him to have been the same Dr. Black had spoken of.

London, May 12, 1825.

XIV.—*On the value of Water, as a Moving Power for Machinery. By Professors* LESLIE *and* JAMESON*.

AT the request of Michael Linning, Esq., we accompanied him on Monday, the 28th of April, along the course of the Water of Leith to Harper's Rig, on the slope of the Pentland Hills, the proposed site of a reservoir. There we found a defile opening into a natural basin of considerable extent, which, on examination, appeared to us capable of being easily and safely embanked. Next day we visited

* From their report, in regard to the Water of Leith. Edinburgh Quarterly Philosophical Journal, No. XXV.

the Harbour of Leith. We have since compared our observations with the several statements laid before us; and having framed some calculations on the authority of Knox's accurate county map, we now beg leave to make our general report. On the whole, we accede to the opinions expressed by those able engineers, Mr. Stevenson and Mr. Burstal; and cannot help regarding the objections stated on this occasion by Mr. Chapman, as destitute of any solid support*.

The facility of erecting a steam-engine almost on any spot, seems to have diverted the public from attending to the vast utility of steady water-falls. The action of what is called *a twenty-horse power engine*, is just equal to the impulse given by 1000 cubic-feet of water falling in a minute through the height of 10 feet. But the yearly cost of an engine of that dimension is, under the most favourable circumstances, estimated at £1000; which is, therefore, the annual saving procured by such a fall of water. The perpendicular height of the proposed reservoir above the sea, we found barometrically to be 884 feet; estimating the quantity of discharge by the Water of Leith when full, at 1200 cubic-feet every minute. The whole force thus evolved by the descending stream, if rightly husbanded and directed, would be equivalent to the action of 106 steam-engines of twenty horse-power. The annual value of the different falls that could be procured along the river, when equalised throughout the year, by the supplies furnished in the dry season from the reservoir, must amount at least to £106,000. But this large saving or income is not merely advantageous to the proprietors of machinery established in the vicinity of our northern metropolis, but would contribute most materially to the wealth and prosperity of the country. It would create,

* Mr. Chapman, in a printed report, maintains, that the erection of a reservoir in the course of the Water of Leith, would prove highly detrimental to the Harbour of Leith, while Messrs. Stevenson and Burstal are of opinion, that the operation of the water of such a reservoir would prove most beneficial to the Harbour.—Editor.

for the use of the state, as great a store of labour as could be produced by the annual expenditure of half a million. An object, therefore, of such vast moment, seems to claim the special patronage of the patriot and legislator.

But the Water of Leith is to be considered as only a mountain-stream, and, therefore, liable to very great inequalities. Its whole annual discharge might be furnished from a surface of twenty square miles. The lower part of the current receives few feeders; and the main supply of water is derived from a moorish tract of about fifteen square miles on the south side of the Pentland Hills. The sudden melting of snow, or a heavy fall of rain on these grounds, will sometimes send down, in a single day, as great a body of water as commonly flows in ten. To intercept or retain a part of these flows, especially when they happen during the dry season, is the principal object of the projected reservoir. Such floods are considered by Mr. Chapman as operating beneficially, by cleansing and scouring the harbour of Leith; and he therefore concludes, that embankments absorbing part of the torrent, and diminishing its force and volume, must so far prove hurtful to the interests of navigation. But pressing this argument, he has overlooked or misconceived the true principles which occasion the gradual forming of banks or bars in estuaries. It is always where turbid and agitated water becomes still, that deposits are made. The stillness, again, is produced either by the pressure of a swelling tide, or by the countervailing influence of two parallel and opposite currents along these mutual boundaries. The size of the particles of foreign matter which a stream is capable of carrying with it, depends nearly on the velocity. A slow motion is sufficient for suspending the very minute particles of clay and soft earth. A quicker flow will transport the finer sand: a greater celerity will sweep the coarser sand, and even gravel; while the rapidity of the torrent is capable of hurling onwards gravel, and even stones. But the river of Leith never acquires any great velocity.

Heavy rains or melting snows may wash the moorish surface of the Pentland-ridge, and bring down mixed with clay the finer parts of the peat earth; but, as the waters swell by accumulation, they find a wider vent in their passage through the low-grounds, and advance with a moderate velocity to the sea, carrying clay and mud, but seldom any grosser matters. In the harbour of Leith, the motion is impeded by various causes, by the bridges, the ships, and above all, the pressure of the flowing-tide, and a slow deposition of the suspended particles is thus made. When the tide ebbs, the turbid waters, no doubt, escape beyond the harbour; but they are partly brought back again by the returning tide. The floods which, at times, descend from the Pentland Hills, so far from helping to clean the harbour of Leith, have a decided tendency to choke it. The erection of the proposed reservoir would hence be of real service to the harbour of Leith, since it would detain the greater parts of the dry and soft earthy matter which are now carried down successively, and deposited in the estuary.

XVI.—*On methods of preventing the accidental Discharge of Fire-arms. Invented by the Rev.* JOHN SOMERVILLE, *Minister of Currie, near Edinburgh**.

AT a meeting of the Society for the Encouragement of the Useful Arts, held on the 21st day of December, 1824, a committee was appointed to examine and report at next meeting, to be held on the 4th day of January, 1825, on the Rev. Mr. Somerville (of Currie's) method of preventing accidental discharge of fire-arms; and the following report of the committee, subscribed by the members of it, viz.—Wm. Wallace, Esq. professor of mathematics in the University of Edinburgh; Thomas Kinnear, Esq. banker, Edinburgh; Dr. Brewster, editor of the Edinburgh Encyclopædia, secretary to the Edinburgh Royal Society, &c.;

* From a tract, just published, sent to us by the reverend author.

James Jardine, esq. civil engineer, Edinburgh;—having examined the Rev. Mr. Somerville's contrivances for preventing the accidental discharge of fire-arms, we are of opinion that they evince much ingenuity, and are admirably adapted to prevent those fatal accidents which are so common in the field, and which are particularly apt to occur when loaded guns are entrusted to servants, or exposed to the curiosity of children or ignorant persons. A gun, constructed on Mr. Somerville's principles, may be considered as locked; and that form of it in which the main spring is secured, is incapable of being discharged, unless by a combination of circumstances which must almost always be the result of design, and which necessarily takes place, without any effort or recollection on the part of the sportsman, when the gun is raised to the shoulder for the purpose of being fired.

In consequence of this security against accidental discharge, the sportsman is enabled to carry his fowling-piece full cocked; and while he is thus prepared for all unexpected rises of game, he is enabled, in ordinary circumstances, to go up to his game with a self-possession which must be highly favourable to his success.

WM. WALLACE, *Prof. Mat.* D. BREWSTER,
THO. KINNEAR, JA. JARDINE.

Another testimony to the merit of these safety-locks for guns was also afforded by John Leslie, Esq. professor of Natural Philosophy in the University of Edinburgh; who says, "It appears to me a very simple and happy contrivance, well calculated for obtaining such a desirable object as preventing the discharge of a fowling piece, till the moment it is presented, and the the left hand has applied its grasp."

REV. SIR, *Edinburgh, 10th Jan.* 1825.

I have examined your safety-lock with much attention, and, I may add, with no less pleasure. The waste of human life which it must prevent, and the tranquillity and

self-possession it must give in circumstances not hitherto divested of the idea of danger, render it a subject of congratulation, not to yourself only, but to every one who may come within the reach of a loaded gun.

Till I saw it, I could not have imagined that such perfect security could have been combined with so much expedition. The instant your gun can be brought to the shoulder, it may be discharged without distraction of thought or waste of time in any previous or preparatory operation. The game may absolutely be on the ground with it, before the locks of the common gun can be both cocked.

Security, however, was the great *desideratum.* Not only the unskilful, but the most experienced, when they have discharged one of their barrels, are sometimes found reloading it, or carrying their gun in the vicinity of their companions, while the other is left on full cock; and this incautiousness, or rather want of recollection in the bustle and engagement of the moment, is every year the occasion of the most distressing accidents. No sooner, however, is your gun brought down from the shoulder, than all is safe, —the action of the spring which stops the movement of the lock, coming in place of the uncertain precautions which have hitherto depended on the recollection and the will.

That your gun should go off, any otherwise than by design, I consider as amounting nearly to an impossibility. As it requires both the hands to act at the same time and in separate places, *one* accident, such as is often fatal with the present gun, is not sufficient to discharge it, and *two* accidents must occur, under the four following circumstances, to give the possibility of danger:

1. The two forces which occasion the accidents must come into operation at a given distance from one another viz. at the distance at which the hands operate, and at no other. Now, of a thousand accidental forces which would singly be sufficient to discharge the common gun, it does not appear probable that there would be one instance in which any *two* operated exactly at this distance.

2. The places in which these two forces operate must be in a given direction from one another, namely, in the line of the gun, and in no other. And of the same number of accidental forces as before, it is equally improbable that there would be two of them exactly in this direction from one another.

3. The forces must each pull or push in one given direction, namely, in the direction in which the hands act in discharging the gun, and in no other. The improbability of this occurrence is certainly as great as we have estimated either of the former.

4. The two forces must unite their action in one instant of time, and not follow one another at any interval,—an instance of which is certainly not likely to occur among a thousand accidental forces.

Combining these various chances together, as must be done to produce an accidental discharge of your gun, and confining the rate of accidents to one in ten, instead of one in a thousand, as we have supposed, it follows, that the common gun will go off by accident ten thousand times for once that yours will be discharged in the same way. Had I retained the rate of one to a thousand, the number would have become almost too great to be expressed by words; and, indeed, taking every circumstance into view, I am inclined to think the chance of injury from your gun, while it is kept in proper repair, is scarcely within the limits of calculation or numerical expression.

The introduction of such an improvement will also have another important effect, upon which you have not perhaps calculated. The life of man being protected from the danger of chance, will be rescued also from those of design; and wherever it is lost by fire-arms, the guilty will find the plea of accident unavailing. I am, &c.

WALTER NICHOL, M. A.
Lecturer on Mathematics.

To the Rev. JOHN SOMERVILLE, M.A. *Minister of Currie.*

Manse of Currie, July 19, 1825.

The *principle* of these patent methods of preventing accidental discharge consists in calling in the aid of the *left hand;* so that while the ordinary gun in common use can be fired off solely by the action of the right hand, the gun now to be described requires both,—the left hand to undo the stop, slide, or catch, by which the gun is locked, and the other to draw the trigger, the same as in an ordinary gun; the *left hand* being equally necessary to work the gun in the field as the right.

The principle now described may be varied to a great extent; all the variations, however, necessarily flowing from this principle; for, having found a genuine one, all the varieties naturally flow from it, as branches from one root, as springs from one source. The inventor, however, confines himself at present to the description of the two following methods.

1. The first method, then, here described, prevents accidental discharge by means of a stop, slide, or catch, situate on the trigger-plate, and either lying on or bedded into it, as the gunmaker or sportsman pleases. It is pressed forward into a slit in the trigger by a spring situate behind it, under the strap of the guard, and thus prevents the trigger from acting or pressing by any accident on the seer of the lock, by which the gun would be discharged. On the fore part of the guard, where the hand presses, is a moveable part called a key, which may be removed at pleasure, and operates on the stop in the act of discharging the gun. When this key is removed the gun cannot be used till it is replaced.

If the sportsman fires with the left hand forward on the stock of the gun instead of the guard, then the key can be placed forward to any part of the stock; and in that case the end of the stop towards the left hand must run forward to that part of the stock, and then receive the key. This key, which may be of any form or size, is removeable at pleasure.

The second method here described prevents accidental discharge by means of a peg screwed into the end of the main spring next to the swivel, or into the swivel itself. The peg may be also solid, that is, a part of the swivel itself, the end of the swivel being lengthened, and shaped into the form of a peg. This peg, when the gun is fired, passes down through a hole or opening towards the trigger-plate of the gun. The gun is prevented from being discharged by means of a slide opening and shutting the hole at pleasure, through which the peg descends when the gun is fired. This slide is pressed forward into the hole or opening through which the peg passes, in a similar way to the one just now mentioned in the foregoing method. When the gun is fired, the left hand, by a gentle pressure, throws back the slide, and thus lays open the hole in the stock and trigger-plate, and allows the peg to pass downward, and of course the mainspring to traverse its full distance. Keys are fixed upon and removeable at pleasure from this gun, the same as in the former method just described.

Having now described this gun, and stated the principle upon which the security is obtained, we now beg leave to mention, in a few words, some of its advantages.

The first advantage, then, which this gun has over the ordinary one in common use, is the *complete security* which it affords against accidental discharge, and the consequent preservation of human life. This is the first and great object of the present contrivance, and in this point of view was first thought of by the inventor. The other advantages which it possesses are all subordinate to this, and come in merely as subsidiary to the main object.

The waste of human life by the accidental discharge of fire-arms is truly deplorable. It is not without reason that writers have cautioned sportsmen to be careful in using them, and that parents have felt anxiety about their sons when engaged in field amusements with weapons in their hands so precarious in the use, and so fatal in their effects. Too frequently the sprightly and spirited youth, in pursuit

of pleasure, finds death! Not only every season, but almost every week of every season, brings accounts of the most valuable lives lost in this way. The inventor, within the narrow space of little more than a year, the time since first he began to notice such accidents, has marked, within the limits of his own observation, about not less than sixteen or eighteen lives lost by the accidental discharge of fowling-pieces. The death of a fine youth of eighteen, the eldest son of his family, and belonging to this parish, occasioned in this way, and accompanied with the most tragical circumstances, first led the inventor to think of this subject, and since he has been in the habit of marking similar occurrences, a list of which, with dates, names, and designations, he will probably give on some future occasion. In the mean time he states it as an undeniable fact, that, at an average, there are not fewer than from twenty to thirty lives, throughout Great Britain and Ireland, lost every year in this way, besides more than double that number maimed and wounded. Now, against such fatalities the gun we are now speaking of presents the most *absolute* security. Any one may be satisfied of this who will consider for a moment the principle upon which it is constructed. Morally speaking, accidental discharge with this gun is completely out of the question, at least the probability of it is so wide, that perhaps philosophy could not calculate when this gun would be discharged in any other way than by design. If accidental pressure shall touch the trigger no evil happens, because it is locked; if it touch the key no evil happens, because the pressure by that time is supposed to be removed from the trigger. The pressure must be against the trigger and on the key at the same instant of time, otherwise the lock will not work. If the trigger is touched the twinkling of an eye before the key, or the key before the trigger, then no evil can ensue; for unless touched at the same instant of time, they mutually counteract and support one another, and thus prevent the gun going off. Accident *may* touch the key and the trigger of *this* gun as well as

any other; but then accident cannot touch *both* key and trigger at the same instant. Design only can touch *two* specific points at *one* specific time. If accident do touch the key and trigger, it must be in succession; but successive touching will not fire the gun. It must be simultaneous to do it; but this supposes thought, and thought supposes design. Inspection of the gun, however, will make this more palpable than any words can; and to the gun we refer, to confirm what has been said.

The second advantage which this gun possesses over the ordinary fowling-piece is *superior dispatch.* This is evident at first sight, as *this invention enables the sportsman to go with his gun full-cocked,* and thus, when game rises unexpectedly, saves all the time lost, as well as distraction of thought occasioned by cocking the ordinary gun, and, consequently, he has only to present and discharge his piece, which he is enabled to do before the gun in ordinary use can be cocked and brought to the shoulder. So sensible are sportsmen of the advantage of having their fowling-pieces full-cocked, that the writer knows some of them who always go with their guns thus prepared, though at the risk both or their own and their friends' lives. Such a practice, with the ordinary gun, is certainly dangerous in the extreme; and the man who does so had better carry a "walking-staff than a fowling-piece." The present invention, however, renders this practice not only harmless, but advisable, as it both prevents dissipation of thought, saves loss of time, and affords at the same time the most perfect security. The inspection of the gun will show this also.

The third advantage which this gun has over others, is the *ease* and *tranquillity of mind* which it necessarily imparts, *not only* to the sportsman himself, but to his friends, parents, relations, or guardians at home, from the perfect security which it affords him. No man of ordinary feeling can be perfectly at ease when surrounded by his friends with a loaded gun in his hand, leaping walls, crossing ditches,

brushing through thickets, underwood, and hedges, when all the while the life of his friends is within the reach of a mortal weapon, and the danger of that weapon guarded against only by the fallaciousness of memory, and the risk increased ten-fold by the eagerness of pursuit, and the suspension of thought necessarily occasioned by a species of amusement which, more than any other, lays caution asleep, and occasions that flutter and hurry of spirits from which such fatal accidents generally spring. Many a melancholy fact attests the truth of the above remark. Even the most cautious man living, in the eagerness of pursuit and the hurry of the moment, is sometimes off his guard; and with the young sportsman this is the case to an extent which those experienced in such pursuits only can know. Now this gun will set all anxiety about our friends completely at rest, as it cannot be discharged till the mind is made up to fire, and the gun brought to the shoulder,—as it may be considered completely locked except when levelled at the object, and in the very act of pulling the trigger; for the moment it ceases to be levelled at the game, the returning action of the safety-spring locks in the gun, and thus, not only without the consent, but even contrary to the will of the sportsman, protects both himself and his friends. The state of mind thus superinduced and preserved, will not only give a new zest to shooting, but will put and keep the sportsman in the most favourable state for killing game, as coolness and ease of mind are essentially necessary to do so with success.

The fourth advantage which this gun possesses, is the sociality of feeling which it will communicate to the favourite amusement of shooting. In the present state of the ordinary fowling-piece, the writer knows many gentlemen who will not shoot in company, from the uneasiness they feel both on their own account and on that of others. It is certainly no very pleasant thing, in the present state of fowling-pieces, as must be the case when shooting in company, to walk all day with two fatal tubes opposite one's

heart, which any neglect or incautiousness on the part of your friend might render fatal in a moment. It is not easy to say here which situation is the more unpleasant, that of him who is always in such danger, or of him who occasions it. However that may be, from a mutual sense of ease and safety, the amusement of shooting is generally a solitary one. With this gun it need no longer be so, as your friend, if seen by you, cannot be in the slightest danger, as it cannot be fired unless when brought to the shoulder and deliberately levelled at the object.

The fifth advantage which this gun possesses, is the safety which one of the modes of it gives to the left hand, in case the gun should burst. All good writers on the subject of shooting, strongly recommend the sportsman to press the gun to his shoulder with the left hand, close on the fore part of the bow of the guard. Notwithstanding, this caution and advice are frequently neglected; and the loss or laceration of many a left hand, by the bursting of the barrel, has taught the sportsman the folly of doing so. With the ordinary gun, indeed, a man *may* fire with his left hand close to the guard, and thus preserve it. With one of the modes on which this is constructed, he *must* do so, for there the safety-spring is placed, and until it is touched the locks are immoveable.

The writer has made several experiments on the two modes of shooting, namely, with the left hand forward on the stock, and back on the guard, and the result is decidedly in favour of that mode which fires with the left hand on the fore part of the guard. That this is the safer mode no person will dispute, but it turns out also to be the most expeditious and certain. Any one may satisfy himself of the truth of this by making the experiment. Let him, with a watch having a momentary movement, try how often he can present his gun at a given object (say) in the space of five seconds; and he will find that, with his left hand close upon the guard, he will present it both somewhat quicker and with greater precision than he is able to do with his

hand placed forward on the stock. It will be found also, that, by this mode of shooting, not only superior safety is obtained, but also that the left hand has much greater power, can traverse the gun with much more ease from right to left, or from left to right, than in the other position. In this mode of shooting, the sportsman turns, as it were, on a pivot; and it makes little difference whether the bird flies from left to right, or from right to left; whereas, with the left hand stretched forward on the stock of the gun, besides the danger arising from its bursting, it is almost impossible to follow a bird when going to the right.

Nothing is more easily acquired than this mode of shooting, even though the sportsman has been accustomed to fire with the hand forward on the stock. The habit can be acquired by presenting an empty gun for a few times in this way, before going to the field; for by an instinctive feeling, which perhaps it is not easy to explain, the left hand, after a very little practice, will come as infallibly to the fore-part of the guard, and even without the sportsman being sensible of it, as the right hand comes to the trigger. The touching of both being equally necessary to discharge the gun, nature quickly and instinctively teaches the necessity of this; and it will thus be found, that the sportsman necessarily and infallibly does so, without being sensible that he has made any change whatever in his mode of shooting. Habit is every thing; and one habit is as easily acquired as another, and surely of two habits a wise man should prefer the best.

With one of the keys of this gun, too, even though the sportsman should persist in shooting with the left hand forward, it will be rendered much safer than with the ordinary gun. This key is affixed to any part of the fore-stock the sportsman pleases, and is so made, that the left hand, which seizes it when the gun is presented, is completely prevented from coming in contact with the barrels, and consequently runs much less risk of injury should they

burst on being discharged. For this we refer also to the gun.

Both on this point, and on the danger arising from accidental discharge, the writer begs leave to quote an authority which will not be disputed.

Daniel, in his valuable work on rural sports, has the following observations on these subjects: "In shooting with a stranger," says he, "who perhaps keeps his gun cocked, and the muzzle usually pointed to the left, plead for the *right-hand* station, and that you cannot hit a bird going to the left; with a game-keeper take the right-hand without ceremony. In getting over a fence, constantly endeavour to go last, notwithstanding the usual assurance of *My dear sir, I am always remarkably careful;* and if a person beats bushes with a cocked gun, get out of his company *as a shooter* with all possible expedition.

"Always," continues he, "hold the gun with the *left hand close* to the *guard*, (and *not forward* on the barrel to grasp it near the entrance of the ramrod, notwithstanding it has been so strenuously recommended,) all the requisite steadiness in taking aim, and even of motion, in traversing the flight of a bird, can be obtained by thus holding the heaviest pieces; and in case of a barrel's *bursting*, the *certainty* of having a hand or arm shattered by *grasping the barrel* is reduced to the chance of escaping the effects of such an accident by placing the hand close to the guard beneath it."

The sixth advantage which this gun possesses over the ordinary one is, that it avoids the tear and wear of the locks, necessarily occasioned by perpetually cocking and uncocking the locks of the ordinary gun in the field. With the ordinary gun, the moment the dogs point, or seem to point, both locks are cocked, and if there happens to be no game, or it rises beyond the reach, the gun must be uncocked again; so that with the ordinary gun the sportsman, during the whole day, is perpetually cocking and uncocking his gun. The tear and wear of the locks is thus

immense, besides both the trouble and the *danger* it occasions. The writer once saw one gentleman very near shoot another when bringing his gun to the half-cock. It happened in this way: the one gentleman, when bringing his gun to the *half*-cock, put his thumb, by mistake, on the *right*-cock, and his finger to the *left*-trigger. The gun thus went off within a few yards of his friend, who, had he been in the *direction* of the gun, must inevitably have been shot. From attacks of this sort, the gun we are now describing presents perfect security; besides occasioning no tear and wear of the locks, for it is not cocked more frequently than it is fired.

The seventh advantage which the writer now states is, that he thinks a steadier aim can be taken by this mode of holding the gun than in the ordinary way. He is convinced that one great cause of bad shooting is occasioned by grasping the gun too firmly with the right hand, or by giving the right hand too much to do in the act of firing. The more easy the right hand holds the gun, and the less it has to do, with the greater precision it will act on the triggers at the proper time. The right hand, therefore, should hold the gun very loosely, and have only one thing to do, namely, to pull the trigger when the gun comes into the proper position to be fired. Now, the gun we are considering, admits of this to the fullest extent. With it the left hand, as it were, does the whole work, except pulling the trigger. The safety-spring being worked solely by the left hand, it should press the gun firmly to the shoulder, by which the asfety-spring will be unlocked, and thus leave the right hand at perfect freedom, and with nothing to do but merely to touch the trigger when the gun comes into the proper situation to be discharged. Thus, by giving the left hand more to do than in the ordinary gun, and therefore proportionably easing the right, the writer thinks his gun will be held more steadily the shoulder, a surer aim will be taken, and greater execution done

than with the gun in common use, and in the ordinary mode of shooting.

The last advantage which he now states is, the security which it gives to loaded guns when lying in houses, or exposed to the curiosity of thoughtless or ignorant persons. Many a life has been lost by guns having been presented and fired off in a wanton and incautious manner. Such accidents cannot happen with the present gun. To render it perfectly harmless, it is only necessary to take off the key, which is done by the slightest touch, and then the machinery which locks in the gun cannot be touched, and, consequently cannot be fired. The key is restored with the same ease as it is removed, and thus the gun prepared for being fired, or not, at pleasure.

JOHN SOMERVILLE.

XVII.—*On the advantages of employing air loaded with moisture, or, still better, Steam, for exciting the fires of Forges, Steam-engines, &c., when supplied with Gas-coke or Stone-coal as fuel.*

IT has constantly been experienced that *air* abounding with *moisture* has been found most efficient in exciting those fires which are supplied with *coke*, as fuel: but it now appears that *steam* is still more effectual, and that even *gas-coke* can now be used as fuel in furnaces with great advantage in point of economy, and, of course, without producing the least smoke, an object of no small consideration in this metropolis, and other populous neighbourhoods.

Mr. Evans, of Bread-street-hill, coffee-roaster, has a small high-pressure steam-engine with a *wrought-iron* boiler; and in order to avoid making smoke, he endeavoured to use *gas-coke* as fuel; but, notwithstanding all his exertions, he was unable to raise his steam higher than from eighteen to twenty pounds pressure on the square-inch, and which was quite insufficient for his purpose.

He at length luckily thought of availing himself of the steam, which was directed into the chimney, after escaping from the engine as usual; and accordingly had a lead-pipe, with a stop-cock soldered to the waste steam-pipe, and led under the grate of the fire-place in the boiler. This contrivance proved most effectual; and now, after having previously kindled his fire with coal, he constantly feeds it with gas-coke, and easily raises his steam to from 32 to 35 pounds upon the inch, and with an economy in fuel, of nearly one half.

The Editor called upon Mr. Evans lately, on hearing of his success, and he convinced him that not only was his fire greatly excited by the use of the steam, but a great quantity of *hydrogen* was also formed, from the decomposition of the water in the steam, and which he thought might be collected and applied to various useful purposes; and, in fact, on opening the furnace door a little, the flames of the burning hydrogen rushed out in great abundance.

He intends to add a cast-iron pipe, perforated with a row of holes underneath it, to the end of the lead pipe, and to extend the whole length of the bars of his grate, in order to equalize the distribution of the steam through the furnace; which, probably, may be an improvement.

On leaving Mr. Evans, the Editor found a friend of his endeavouring to heat a high-pressure steam-boiler with *stone-coal* or *anthracite*, in order to avoid making a smoke. The Editor advised him to add a leaden conducting pipe to the nozzle of one of the trial cocks, used to ascertain the proper quantity of water in the boiler, and to bring it under the grate, in order to excite the fire by the steam; he accordingly did so, and instantly found the advantage of it, in the enereased heat of the fire. This experiment deserves to be prosecuted farther; for if *stone-coal* can be successfully employed in furnaces, its low price, great abundance, and perfect freedom from smoke, will render it exceedingly useful to the public.

In cases where other furnaces than those of steam-en-

gines are to be excited by means of steam, it may even be well worth the trial of employing a small boiler to produce the steam.

It must be highly desirable in steam-boats to employ coke or stone-coal as fuel, in order to avoid the smoke; and to excite the fire by using a portion of steam in the above manner; and which, indeed, is the more requisite, on account of the necessary shortness of the chimneys in steam-boats not allowing of a sufficient draft in their furnaces to burn those substances with advantage.

XVIII.—*On a recent Explosion of the Boiler of an American Steam-boat, occasioned by wanton mischief.*

We have just been favoured with some particulars of the above explosion, by one of the sufferers under the consequences of it.

About two months since, two steam-boats were running a race against each other, in one of the extensive rivers of the United States; when, in order to increase the power of the steam, a person on board one of the boats, *actually sat upon the safety-valve, and prevented it from rising;* and the consequence, as might have been expected, was, *the blowing-up of the boiler!*

Our informant was covered all over with the charcoal, ashes, &c. from the fire; was carried several yards, by the force of the explosion, and had his leg severely injured, by striking against the taffrel of the vessel.

We need hardly add, that he made no delay in securing his specie, luggage, &c.; and, quitting the vessel in which his life had been so nearly sacrificed, he instantly embarked on board the other steam-boat.

We cannot sufficiently reprobate the fool-hardy conduct of the party, who thus hazarded his own life, and the safety of all on board the vessel.

THE

TECHNICAL REPOSITORY.

XIX.—*On improved Cast and Wrought Iron Furnace-Bars. by the* EDITOR.

WITH A PLATE.

On improved Cast-iron Bars.

THE usual cast-iron furnace-bars are of the shape of the two shown in section at fig. 1 of plate IV.; and by a side-view of one of them in fig. 2: being made broad above, and tapering to their lower edge; having also square blocks at each end of them, to lodge upon the bearing-bars, and keep the bars a proper distance apart, to allow the air to pass between them, to feed the fire.

The defects of these furnace-bars are, that they permit clinkers to form upon them, and that they very soon become burnt away in the middle, and bent, as shown in fig. 3, and consequently nearly useless; or which is still worse, they are very liable to melt, or burn through.

We had the first notice of the improved cast-iron bars about to be described, from a manufacturing chemist at Dublin, three years since, but could hardly credit his information thereon. Lately, however, Mr. George Manwaring, engineer, of Marsh Place, Lambeth, has again called our attention to the subject, and furnished us with such abundant proofs of the superior excellence of these improved bars, that we could no longer withhold our belief therein; and have accordingly thought it incumbent upon us to bring the improvement fully before the notice of our readers.

Fig. 4 is a section of one of these improved cast-iron furnace bars: fig. 5 a side view, and fig. 6 a top view of it; all drawn to the same scale; and fig. 7 is a represen-

tation of several of them, lodged upon a bearing bar in the fire-place as in use.

It will be seen, from these figures, that there is a semi-cylindrical hollow or furrow, made along the middle of the top of each bar, and that each side is thinned away below very considerably, to the web or fin, which forms the central, and supporting part of each bar in the middle of it. And it is yet a doubt whether the great durability of these bars is owing to the lodging of *ashes* from the fuel, in the hollow top of each bar, and which, acting as an imperfect conductor of heat, prevents the immediate action of the fire upon it, and the consequent formation of clinkers; or, whether it be owing to the rush of air below, which cools the bars in its passage to the fire; or, which is more probable, to the joint action of both these causes; however this may be, the effect is, that these bars endure the action of the fire, for a great length of time, without any injury. We have just seen an instance, *in bars of the common construction being burnt through in a very short space of time;* whilst in the very same furnace, and under the same circumstances, *a bar of the improved form, taken from the middle of the grate, where it was exposed to the greatest heat, was found, after an endurance of eighteen months, to be entirely uninjured.* It remained perfectly straight, its edges were still sharp, no clinkers had formed upon it, and its durability promised to be at least as long as ever.

There is also a great economy of iron in the construction of these bars, over the massive common ones, which is another consideration of some importance. Mr. Manwaring has experienced the benefit of them in repeated instances, and particularly in the fire-place of a steam-engine, which is very frequently at work night and day without intermission, or allowing the bars to cool. The instance we saw, was in the furnace of a copper, in a public brewery; the bar was rather more than two inches in breadth.

On the substitution of Wrought-Iron for Cast-Iron, in Furnace Bars.

We have several years since had our attention directed to the advantages of using *wrought-iron*, on account of its greater infusibility, instead of *cast-iron*, for the bars of founders' wind-furnaces, &c.; and then saw *square* bars applied to this use, in the manner represented in fig. 8; they were lodged with one angular edge above, and another below, in angular gaps or notches, made in the cast-iron bearers to receive and retain them in their proper situations thereon. One of these bearers is shown in section in fig. 9, it having a hollow furrow made underneath it, to save iron. We have, however, lately been informed, that an eminent soap-boiler, at Lambeth, has found that *round bolt-iron* forms the best furnace-bars for his use; such an application of it is shown in fig. 10; the bars being lodged in proper semicircular gaps, made in the cast-iron bearers to receive them.

XX.—*On the Mineral History of Gold, and the separation of it from Earthy and Stony Bodies, by Water, Mercury, &c. By the late* WILLIAM LEWIS, M. D.

[*Continued from page* 59.]

THERE are sundry European rivers which roll particles of gold with their sands in no great quantity, yet such, that the neighbouring inhabitants, at certain seasons, find their account in collecting them. M. de Reaumur, in an essay in the French Memoirs for 1718, drawn up from materials furnished by the intendants of the several provinces, in pursuance of the orders of the Duke of Orleans, gives an account of ten rivers or rivulets in the territories of France, that have gold mixed with their sands in certain parts of their course: the Rhine, from Brisac down to Strasburg, sparingly; from thence to Philipsburg, more abundantly; and most of all so between Fort Louis and

Germesheim. The Rhone, in the Pais de Gex, from the conflux of the Arve, from which it is supposed to receive its gold, to about five leagues lower down: the rivulets of Ferriet and Benagues, which rise from the heights on the left hand of the descent from Varilhere to Palmiers: the Ariege, *aurigera*, about Palmiers, below where it receives the two foregoing rivulets: the Garonne, some leagues from Toulouse, below where it receives the Ariege: the Salat, which rises, as the Ariege, in the Pyrennees: the Ceze and the Gardon, which come from the Cevennes, and the Doux, in the Franche-Compte. The last of these rivers is the poorest, the gold having hitherto been collected from it rather in the way of curiosity than with a lucrative view: the greatest quantities are obtained from the Rhine, not that this is really the richest, but on account of its sands being the most industriously searched; for some of the others, particularly the Ceze and the Gardon, appear to be at least equal to it in richness. The quantity got from the Rhine, in an account of near two leagues below Strasburg, is said to amount to no more than four or five ounces in a year: this is the quantity brought to the magistrates of Strasburg, who farm out the right of collecting it, on condition of its being sold to them, at a price considerably under its value; so that it may be presumed that a part is otherwise disposed of, and that the quantity really obtained, is considerably greater.

There are many other rivers reported to yield gold, as the Tagus, the Danube, the Elbe, the Oder, the Inn, the Sala, &c. The Schwartz, in the county of Schwartzburg, in Upper Saxony, is said to be rich in this metal, and its sands to be worked with great profit: Stahl mentions a piece found in it as broad as a middling bean, though not so thick, and supposes that the Sala receives all its gold from this river; the gold of the Sala being found only below where the Schwartz enters it, and being less plentiful, and in smaller grains. It is generally reckoned that the gold particles, in all auriferous rivers, are washed out

by the stream from such rich beds, and afterwards rest or settle where the current is languid, or in places where they escape its force: from what particular sources the gold in different rivers proceeds, does not seem to have been examined.

The richest parts of rivers, within the extent in which they roll gold, are those where their course is slow and uninterrupted, where they widen or change their direction: the most favourable season is when the water has subsided after a flood. The appearance of the sand affords an useful mark of distinguishing the richest spots; the gold being always most plentiful where the sand is reddish or blackish, or of a colour somewhat different from what it is seen elsewhere; not that the red or black sands have any natural connexion with the gold, but on account of their being more ponderous than the white; so that the same cause which determines the particles of gold, determines these also to subside. The black sand abounds with iron, being vigorously attracted by the magnet; the red, viewed in a microscope, appears, as Reaumur observes, a beautiful congeries of coloured crystals, imitating all the gems known to the jeweller, among which, those of the ruby and hyacinth tints are the most common; whence the reddish colour of the sand to the naked eye: the particles of gold are of irregular figures, but constantly flat, smooth, and with the edges rounded off.

Some gold has been discovered in Britain at different times, though, hitherto, in little quantity. Instances are mentioned in Houghton's Collections, from Camden, Sibbald, and Gerard de Malines, of gold found in Scotland, about the head of the Clyde, in Crawford-moor; and Boyle says, he had from some part of Scotland, divers large grains of gold, taken up near the surface of the earth, over a lead mine; one of which, clear from spar, weighed two hundred and one grains. Mr. Boyle had also an English tin ore, wherein there lay, in little cells, a number of small leaves or chips of gold: he observes, that, though

the tinmen, unable to separate them to profit, usually melted both metals together; yet he was assured, that one person advantageously employed his children to pick out the gold from the ore, skilfully broken. Some earlier writers mention also gold found in the tin ores of Cornwall; and about the beginning of the present century (1700) a patent is said to have been obtained "for separating gold and silver from tin, by precipitation in a reverberatory furnace, with some peculiar fluxes:" what success this scheme met with, I have not learnt. Mr. Borlase, in his natural history of Cornwall, gives an account of some tin ore, abounding with a yellow matter, which was taken by the workmen for mundic: some bits of the yellow matter, one of which was a vein, as large as a goose quill, included in a stone, the size of a walnut, produced on being melted an ounce of pure gold: he mentions several other pieces of considerable bulk, and gives a figure of one found in 1756, weighing three hundred and seventy-six grains. It is supposed to be chiefly the stream tin, (that is, the tin ore found in detached pieces on the sides of hills,) which contains gold; that all of this sort contains more or less of it; and that both the gold and tin ore have been brought from elsewhere by torrents of water, and deposited where they are now found, like the gold sands of rivers.

Boyle conjectures that, besides the grains of gold which lie detached among sands, there may be many particles so minute and closely fixed to the sand as not to be perceivable by the eye, or separable by the common methods of washing or picking; that many small portions of the metal may be incorporated also with the body of the sand, and that by skilful management they might be extracted. Experiments, he says, confirmed him in this persuasion: later experiments have verified it, and shown the existence of gold in sands to be even more extensive than he seems to have apprehended. Many of the common sands, particularly the yellow, red, black, and those of a black colour inclining to violet, appear to be rich in

gold: Becher and Cramer presume that there is no sand in nature entirely free from it. Hellot relates, that in eleven assays of one kind of sand, made by M. Lieberecht, by a process described in the sequel, the yield of noble metal turned out constantly from 840 to 844 grains on the quintal, or 921,600 grains, exclusive of what remained in the scoriæ, which were still found to be rich; that different parcels of sand, taken up at no great distance from one another, differed in degree of richness, some having afforded above 1000 grains, others only 350, and others yielding none by the treatment which had succeeded so well for the rest; and that of the metal thus obtained from sands, two-thirds are commonly gold, and the rest silver. Yet, notwithstanding the great richness of these sands, no means have hitherto been discovered of availing ourselves of the metal they contain, or of extracting it to advantage in the large way. Becher, indeed, undertook to obtain gold with profit from the common sea sands, and entered into engagements with the states of Holland, for establishing a mineral work on this foundation; but though experiments made on little quantities, promised very considerable gain; and though on trial in the large, is likewise said to have proved successful; yet, as he communicated the whole process to the commissioners appointed to examine the affair, and, as he has shown, that such a work might be carried on more advantageously in Holland than in other parts of Europe, its never having been prosecuted in Holland, affords a strong presumption of its not being sufficiently lucrative. The existence of gold in sands is, nevertheless, an interesting fact, at least to the philosopher; and further examination may, perhaps, find means of making it turn to account.

Though gold has been but lately discovered, or expected in these minerals, in which it is so common and so plentiful, their unpromising appearance having given little encouragement to examine them; there are others, whose flattering colour has raised great expectations, but which

have not been found, upon experiment, to yield any gold. The yellow pyritæ, or marcasites, and other minerals of a golden colour, or containing gold-coloured specks, have, by some, been regarded as ores or matrices of gold, and accordingly submitted to operations as fruitless as expensive: their losing their colour in the fire, or changing it to a yellow, soon discovers that their tinging matter is not gold, but sulphur, or a ferruginous calx. There are indeed, pyritæ which contain gold, and in quantity sufficient to deserve notice. Henckel, in the 12th chapter of his *pyritologia*, gives an account of some assays of minerals of this kind, brought from the Hungarian mines, one of which yielded on the centner, or 1600 ounces, half an ounce of noble metal, of which one fifth was gold, and the rest silver: from the same quantity of another, he obtained no less than sixty ounces of silver, and eight ounces and a half of gold: but the gold, as he observes, is by no means proper to the pyrites, or an essential part of its composition, having been only casually intermixed, as it is in stones and other minerals, in the gold mines.

Many have been deceived also, by some of the talcs: of which there is one species, naturally of a grey colour, which in a moderately strong fire, changes to a gold yellow; and another, naturally of a glittering gold colour, which receives no change from moderate fire: both these bodies have a further resemblance to gold, in imparting a deep yellow tincture to strong *aqua-regia*. By repeated digestion in fresh *aqua-regis* all the colouring matter may be extracted, and the earthy part left white; but the solution yields no gold, and is found to be no other than a solution of iron. Reaumur observes, that spangles of the yellow talc are frequent in the sands of some rivers, and that they may readily be distinguished from gold, which they have often been taken for, by viewing them with a magnifying glass; the gold particles found in rivers being constantly smooth, with the edges rounded, while the talky ones are rugged and sharp-edged.

On the separation of Gold from Earthy and Stony Bodies, by Water.

Gold, intermixed with earthy bodies, in small particles or dust, is separated by washing with water, which carries off the lighter earth, and leaves the more ponderous metal behind: the great gravity of gold, renders it better adapted to this way of separation, than any of the other metals. There are sundry variations in the manner of conducting the process, according to the quantity of the matter, the nature of the earthy body, and the conveniency of the place; many of which are minutely described by Agricola, in his treatise *de re metallica*. It will be sufficient here to give a general idea of the manner of procedure, in an operation merely mechanical, and whose success depends chiefly on manual dexterity, acquired by practice.

Where the quantity of matter is small, it is laid, by a little at a time, in a round shallow dish, called a buddle; or in an oblong vessel, like a boat; which, being gently shaken backwards and forwards in a tub of water, the lighter part of the earth is taken up and washed off, leaving with the gold such sand or small stones as the mixture contained. By dexterously repeating the agitation, that the whole may acquire as it were a kind of fluidity, the metalline particles sink to the bottom, and the sand or stones are thrown up to the top, and may be removed by the hand.

At several of the gold mines of the Spanish West Indies, the gold is completely separated by this simple operation. According to Don Ulloa's account, in his voyage to those parts, the earth, as it comes from the mine, is thrown into a reservoir, a stream of water conducted upon it, the whole stirred together, and the muddy water let off into another and another reservoir, and what it deposits in the others is taken up in trays or buckets with two handles, and agitated in fresh waters with an uniform circular motion, till the gold is collected at the bottom.

M. de Reaumur, in the French memoirs for the year 1718, gives a particular description of the method of washing the gold sands of the Rhine, and some other rivers. A board, five feet long, a foot and a half wide, with a ledge at each side, and at one end; is laid aslope, with this last end on the ground, and the other raised a foot and a half: across the board are nailed three pieces of rough cloth, each about a foot wide, and at distances of a foot; and at the upper end is placed a kind of basket, made of rods. The sand is shovelled into the basket; water thrown on it washes the sand through, the stones remaining: the earth and lighter parts of the sand are carried down to the bottom of the board, while the particles of gold, and the heavy black and red sands, already mentioned, are detained by the rough cloths; which, when they appear covered, so as not to be able to detain more, are taken off and washed in a tub of water, then nailed on again, and the process continued till a proper quantity of this richer sand is obtained. In some places, instead of the cloths, skins, with the hair or wool on, are used; and in others, notches are made across the board. The richer sand, thus detained, is put into a vessel somewhat like a boat, which is gently shaken in water, in the same manner as the sieve in winnowing corn, till the lighter grains rise to the top: these being carefully poured off with the water, the agitation is repeated, so long as any grains of a different colour from the rest, are found to rise. No further separation is to be expected by this method; and the gold, of which some particles begin now to be distinguishable by the eye, is extracted from the remaining matter by mercury, as will be described in the following article.

Gold, bedded in stones, may frequently be separated from great part of the stony matter on the same principle; the stone being previously reduced to powder. In the large way, it is beaten in mills under water, by large wooden stampers, armed at the bottom with iron; an iron grating being commonly fixed at one side of the trough or

pit, through which the finer parts are continually washed off by the water. When a little quantity is to be powdered in a mortar, it should likewise be done *by blows of the pestle, not by grinding: a blow only flattens the metalline particles, while triture wears and divides them, in part, to such tenuity, as not freely to subside in water.* Stones of the hard flinty kind are previously made red-hot, and quenched in water, by which means they are rendered more easily pulverable; and, at the same time, many of the small particles of gold, melting in the fire, unite, and form large masses.

[*To be continued.*]

XXI.—*On transferring old Pictures, from pannels, plaster-ceilings, walls, &c. to new canvass, and straining frames. By the late Mr.* ROBERT SALMON*.

SIR, *Woburn Abbey, Bedfordshire, Dec. 5, 1796.*

BEING assured of the readiness of the Society for the encouragement of Arts, Manufactures, and Commerce, to attend to every proposition of useful invention or improvement, and conceiving that a method of preserving the works of those who have at any time contributed to those improvements may be desirable, induces me to lay before them the account of an art, which, from every enquiry I have been able to make, I am inclined to think new; should it not be found so, I hope this communication will be considered as an attempt to that end, and that it may not be unacceptable to the Society.

The art I mean is, that of transferring paintings from one substance to another, without defacing or injuring the same; by which means any old and valuable pictures, painted on boards, plaster-ceilings, or walls may be transferred from those substances, and placed on canvass or straining frames, so as to be equally sound and durable as

* From Vol. XV. of the Transactions of the Society for the encouragement of Arts, Manufactures, and Commerce.

if originally painted thereon, and thereby rendered more perfect then they are generally found on decayed and broken boards, ceilings, walls, or such other substances, that it may be requisite to transfer them from. By this art any paintings on the ceilings, walls, or wainscots of old buildings, however large, on curved or straight surfaces, and of whatsoever shape, may be preserved from ruin, and handed down to posterity, when otherwise they would be lost.

Such is the substance of my invention, which, after many trials, I have by my own experience, suceessfully put in practice; and, should specimens of transferred paintings appear worthy the notice of the Society, I shall on your request, readily submit some of the same to their inspection; and, not having any intention of taking out a patent for the same, should it be thought an acquisition worthy any reward, I shall, with pleasure, lay the whole of the process before the Society, whenever requested. Flattering myself with the favour of an answer, I am, sir, &c.

ROBERT SALMON,
Clerk of the Works to the Duke of Bedford.

SAM. MORE, *Esq. Sec.*

SIR, *Woburn, Dec.* 12, 1796.

Agreeably to the wish of the Society, I have sent, per the Woburn coach, a case, directed for you, containing two of my transferred paintings; and, in order to explain their present state, I beg leave to lay before the Society the following particulars.—The portrait of Queen Elizabeth was, at the time it came to my hands, on an oak board, broken in four pieces, and lodged together at the back; the other picture, now on canvass, was from a plaster cove of a ceiling of a stair-case, at Houghton-house, near Ampthill, formerly the residence of the Marquis of Tavistock.

I am, sir, &c.

ROBERT SALMON.

SAMUEL MORE, *Esq. Secretary.*

Mr. ROBERT SALMON'S *method and process for transferring Paintings.*

The first thing to be attended to, either for paintings on plaster walls or ceilings, or from boards, is, that the place in which they are be secure from wet or damp. If the painting are on old walls, in large buildings, and places where this cannot be attained by art, then the summer season should be taken for the purpose, as the picture would rarely escape damage if the wet or damp gets at it while under the process; at the same time caution should be taken that the room or place be not overheated, which would also produce equally bad effects: these precautions taken, the next thing is to examine the face of the painting. If there are any holes in the same, they must be carefully filled up with paste, or putty of glue and whiting: this, if the holes are large, should be twice or thrice done, so as entirely to fill up and leave the face even and smooth; but if there are any bruised places, with paint still remaining on the face of the bruised parts, then this stopping must not be applied, but the securing canvass, hereafter described, be pressed down into these places. In the places that are stopped, there will of course appear blemishes when the picture is transferred; but the process is rendered much more certain and sure by being so done. Attention must next be paid, to lay down any blisters, or places where the paint is leaving the ground: this is done by introducing, between the paint and the ground, some very strong paste of flour and water; and the face of the blistered paint being damped with a wet sponge or pencil, it may then be pressed with the hand home to the ground, to which it will then adhere: all the unsound places being thus secured, care must be taken to clear the face of any grease or dirt, as also of any particles of the paste that may happen to be left on the surface. The next thing is, to determine the size of the painting meant to be taken off; and if on a plain surface, a board of the size of the

picture must be procured, of not less than an inch in thickness, and framed together with well-seasoned wood, in small pannels, smooth, and flush on one side: this done, a piece of fine open canvass must be provided, such as the finest sort used for hanging paper on: this canvass to be made somewhat larger than the picture, and so sewed together, and the seam pressed, that it be perfectly smooth and even. This is what I call the securing canvass, which, being so prepared, is then stuck on the face of the picture with a paste made of strong beer, boiled till it is half reduced, and then mixed with a sufficient quantity of flour to give it a very strong consistence. To large pictures on walls or ceilings the canvass must for some time be pressed, and rubbed with the hand as smooth as possible, working it from the middle to the outside, so as to make it tolerably tight, and observing, as it dries, to press it with the hand or cloth into any hollow or bruised places, so that it may adhere to every part of the painting: this done, it is left to dry, which it will mostly do in a day or two. When dry, a second canvass, of a stronger and closer sort, and of the same size as the other, is in like manner to be attached on the top of the first. This last will want very little attention, as it will readily adhere to the first; and, being dry, attention must be paid to the face thereof, to take off any small knots or unevenness thereon; which done, the whole should be again covered with a thin paste of size and whiting; when dry, to be pumiced over, so as to make the whole perfectly smooth and even. The painting being thus secured, the board, already prepared to the size of the picture, is to be put with the smooth side against the face thereof, so as exactly to cover as much as is intended to be transferred. The edges of the canvass, which, as before directed, are left larger than the painting, are then to be pulled tight over, and closely nailed to the edge of the board. If the painting be large, either on ceilings or walls, the board must, by proper supports, be firmly fixed against the picture, so

that it can readily be lowered down when the plaster and painting is detached.

The canvass and board being fixed, the paintings from walls or ceilings are to be freed, together with a certain portion of the plastering: this, with proper care and attention, may be readily done. If on a ceiling, the first thing is to make some holes through the plastering round the outside of the board and painting, and, with a small saw, to saw the plastering from one hole to another, till the whole is disunited from the other parts of the ceiling; this done, the workman must get at the upper side of the ceiling, where he must free the plastering from the laths, by breaking off the keys thereof, and, with a chissel, cut out the laths, whereby the plastering, together with the picture, will be left resting on the board and supports: if there be apartments over the ceiling, the readiest way will be to take up a few of the floor boards above; if next the roof, means may always be found to get into the same; and, although at first this operation may appear difficult, yet it is presumed no difficulty will be found by any ingenious workman.

If the painting is on a brick or stone wall, the same must be cut away at top, and down the sides of the painting; and then, by means of chissels or saws in wood handles, of different lengths, the wall must be cut away quite behind the painting, leaving the same, together with the plastering, resting on the board; this operation may sometimes be done with a saw, or, if the wall be not thick, nor the other side of much consequence, the bricks or stones may be taken out from that side, leaving the plastering and painting as before. This last method I have not practised; the other, of cutting away some part of the wall, I have, and see no difficulty, or very great labour in the operation; but that of course must be various, according to the texture of the wall and mortar.

If paintings are on curved surfaces, such as the coves of ceilings, then the only difference of operation is,

that some ribs of wood must be cut out and boarded smooth to the curve of the surface of the painting, and then fixed up thereto, in place of the before described bearing-board; the painting is then to be freed, and left with the plastering, resting on the bearers.

For paintings painted on wainscot or boards, the same securing and process is exactly followed, only that, as the wainscot or board can always be cut to the size wanted, and laid horizontal, the securing canvass is stretched thereon, and turned over the edges of the same till it is dry; after which the edges are again turned up and nailed to the board in the same manner as those from walls.

Having, as before described in any of the aforementioned cases, freed the paintings from their original places, you have then got them secured to two thicknesses of canvass, with their faces next and on to the board prepared for that purpose; which being the case, they can readily be removed to any room or shop to be finished, as follows. Having got the painting into the shop or room, which should be moderately warm and dry, but by no means overheated, laying the board on a bench or tressels, the back of the picture will be uppermost, and the plastering or wood, as may happen, is then to be cleared away, leaving nothing but the body of paint, which will be firmly attached to the securing canvass; to perform this a large rasp, a narrow plane, and chissels will be requisite: this operation is difficult to describe, but would soon be learned by any one who makes the attempt; nor is it very tedious; and, being performed, the picture is ready to be attached to its new canvass, as follows.

The painting being cleared, and lying on the board, the back thereof is to be painted successively, three or four times over, with any good strong-bodied paint, leaving each coat to dry before the other comes on; a day or two between each will generally be found sufficient. Each of these coats, and particularly the first, should be laid on with great care, taking but a small quantity in the brush

at a time, and laying it very thin: this precaution is necessary to prevent any of the oil or paint from searching through any small cracks or holes that may happen to be in the face of the picture, which would run into the paste, and so attach the securing canvass to the picture as to prevent its being afterwards got off. If any of these holes or cracks are observed, they should be stopped up with the glue and whiting paste, and the painting then repeated till a complete coat is formed on the back of the picture; and it is then ready for attaching to its canvass, which is done by spreading all over the picture a paste made of copal varnish mixed with stiff white lead, and a small quantity of any other old fat paint; all which being spread equally over with a pallet knife, such a canvass as the first securing-canvass is laid thereon, and strained and nailed round the edges of the board, in which state it is left till it becomes tolerably dry; and then a second canvass, of a stronger sort, must be in like manner attached on the first, and left till it is perfectly dry and hard. This mostly takes about two months; and the longer it is left the more secure the painting will be attached to its canvass, and less liable to crack or fly therefrom. When sufficiently dry, all the four canvasses are to be unnailed from the board, and the edges turned up the reverse way, and nailed to a proper stretching frame; this is done by unnailing from the board a part on each side at a time, and immediately nailing it to the stretching frame, so as never to leave the canvass to rack or partially stretch, which would damage the picture; in this manner, by degrees, the cloths are entirely detached from the board, and firmly fixed on the stretching frame; the superfluous canvass left larger than the frame may then be cut off, and the wedges put in the frame, and moderately tightened up. There remains then only to clear the face of the painting from the securing canvass, which is done by repeatedly washing the face with a sponge and moderately warm water; in doing this, no violence or force must be used; with frequent and gentle

washings the paste will all be worked out with the sponge: the edges of the outer canvass are then to be cut round and stripped off, and the other next the face of the picture is to be done in like manner; which done, there only remains to clear the paste clean off, and repair any defects; and the picture will be as strong as if painted on the canvass.

For taking pictures off walls, without taking the walls down, or cutting away more thereof than the plastering, the following process is proposed: The face of the picture to be first secured, in every respect, in the manner before described: instead of the plain board; a bearer should be prepared, with a convex surface, composed of ribs boarded over, so as to form part of a cylinder, of not less than five feet radius, and as long as the height of the picture. This bearer being prepared, in order to apply it, a floor or platform should be erected, and placed horizontally, with its surface level, and its edge immediately in contact with the bottom of the picture meant to be transferred. The use of this platform is for the above-described bearer to move and rest upon; which bearer should be set on its end, with one edge in contact with the wall, at one side of the picture; consequently the other edge will be at some distance from the wall, according to the size of the picture and convexity of the bearer. Being thus placed, the superfluous edge of the securing canvass should be turned over, and nailed to that edge of the bearer that is next the wall: this done, the operation of cutting away the plastering should be begun, which may be done with the corner and end of a short saw, by sawing between the brick-work and plastering, leaving the thickness, or part of the thickness of the plastering, on to the painting, fastened to the bearer; and when this edge of the picture is freed, the whole height, of nine or ten inches under, the edge of the bearer that is furthest from the wall must then be gently forced nearer; consequently the other edge, together with the painting and plaster that is freed, will leave the wall, and give an opportunity of introducing a saw behind, and cutting away

the same to a certain distance further under; and by repeating this, the whole of the picture will at last be freed, and left on the bearer: each time the bearer is removed, and, as it were, rolled on the vertical surface of the wall, care must be taken to turn and nail the securing-canvass on the top and bottom edges of the bearer, so as to secure the freed plastering and picture from moving about; and lastly, before the bearing and painting be moved, to nail the other edge of the picture in the same way, which will secure the whole to the bearer: this done, the picture and bearer are at liberty to be moved to a proper place, in order to be freed from the remaining plaster; the edges may then be unnailed, and the painting and canvas slipped from this bearer on to a plain board, and the new canvass then put on, and remain till dry, as in other cases.

It may appear that the bending of the canvass and plastering to the convex bearer will crack the plaster, and damage the painting; but from experience I have observed that to a curve of such, or even less radius, plastering will bend without any visible crack even on the exterior part thereof; and that part next the bearer not having occasion in bending to extend its parts, will consequently be much less liable to be disturbed by such bending.

SAMUEL MORE, *Esq. Secretary.*

SIR, *Woburn, April* 22, 1797.

In compliance with the request of the Society, I am to inform them that, in clearing the wood of the paintings, I have never made use of aquafortis or any other liquid, the use of which, I conceive, would be very tedious, and attended with danger, lest it should get through the paint, and wet or damp the paste by which the securing canvass is fixed; the consequence of which I have by accident experienced, and find that such places so wetted have been blemished. In working off the wood I have mostly made use of planes alone, the management of which requires some dexterity, but would soon be obtained with care and

practice. The sort of planes I have used are what by the joiners are called the bevelled rebate plane, and small rounds; with the corners of the former, and proper handling of the latter, the wood is got off without force or violence, and the smallest particles may in general be got off, although in some paintings, and in particular parts of others, I have met with places on which I have thought it best to leave some particles, or fine splinters of wood; but in none I found it requisite to leave the thin skin of wood, as suggested by the committee, which I think would prevent the painting being so well attached to its last canvass. The rasps, and sometimes a fine chissel, are useful thoroughly to clear off such parts as may be in hollow places, or where the particles of wood are left, as above. The time required will be various, according to the manner in which the painting was originally done, some being painted on boards previously prepared with a water-colour, others immediately painted with oil on the wood. This last sort is by much the most difficult; the other is more easy, as the previous preparation prevents the wood from imbibing the oil, and consequently admits it to be more easily separated. The head of Christ was a mixture of the two sorts; some parts of it having been so prepared, and others very thinly, and others not at all so done, the which rendered the operation more tedious than any I have before met with, having taken me six hours for three successive evenings: other paintings of the same size I have done in one evening.

I am, sir, &c.

ROBERT SALMON.

XXII.—*On the manufacture of Glue, or Size, for the use of Weavers, Paper-hanging manufacturers, &c.*

GLUE is made from hides, skins, and pelts; the skin of the ears, legs, &c.; and the older the animals producing them are the better.

Hide-roundings are the best material for this purpose,

viz. the clippings of hides, which have only been limed; as leather which has been tanned, or dressed in oil, is of no value for glue or size*.

The proportion of their value for this use is nearly as follows:—112 lbs. of the hide-roundings are equal to making 56 lbs. of glue; the same quantity of chamois-leather or glovers' clippings, not oiled nor tanned, or of alumed or whittawed leather, to 40 lbs. of glue; of hare and rabbit skins, (which are never limed, and are mostly used by buckram-stiffeners and linen-dyers, in consequence of their not having any lime or alum in them), to 35 lbs. of glue; also the same quantity of fellmongers shreds yield from 25 to 28 lbs. of glue; and of parchment slips or cuttings, from 14 to 16 lbs.

A great deal, however, depends upon the various articles enumerated being perfectly free from lime, dust, or dirt, their perfect state of dryness, and their good condition.

The expenses of boiling them into glue are much reduced when the various articles have been soaked in water for 24 hours previous to boiling them in other fresh water.

The quantity of water must be regulated by the strength of the glue or size required; allowing one pint of water for an ounce of glue, or 2 gals. for a pound of glue, for single size.

The hide roundings require one gallon of water for 16 oz.; alumed leather, chamois leather and glovers' clipping, 1 gal. per 20 oz.; hare and rabbit skins, 1 gal. per 24 oz.; fellmongers' shreds, 1 gal. per 28 oz.; and parchment cuttings, 1 gal. per 50 oz.

The exact quantity of water ought first to be put into the boiler, according to the quantity of size intended to be made; and when the article to be boiled into size is added, the depth, or quantity of liquid required to be constantly maintained till the gelatine is extracted by the boiling, will be correctly ascertained; and any visible waste occasioned in the boiler during the operation, must be continually sup-

* Except for the use of the *black paper-case makers*, who use *tanned* leather for making their glue. See Vol. I. p. 416.

plied, by adding the necessary quantity of water; or otherwise considerable time will be lost in the process.

An iron pan or boiler is much better than any other, provided that care is taken to add cold water, by a little at a time, while the boiling is continued. And it is also necessary to have an iron grating placed inside the boiler, in order to prevent the article from burning to the bottom of it, and to lessen the time and trouble required in frequently stirring it.

We have extracted the above useful particulars from the Manufacturer's Assistant, a work containing much valuable information; to which we may also add, that, after the boiling is completed, the clear size ought to be strained from the dregs, to finish it for use. And that the paper-hanging manufacturers prefer to make their white size for light colours of the skin which covers the foreheads of calves, previously freed from the hair by liming them. The skins of soles, and no doubt of other fishes also, after being freed from all greasiness by soaking them in lime-water, will very readily dissolve into a size in water, by the assistance of heat; and which, after straining it clear, may no doubt be usefully employed for many of the purposes of isinglass, &c.

XXIII.—*On Turning Spherical Forms in Wood. By Mr.* THOMAS COOK, *of Newington, Surrey*. With additional particulars, on forming Ivory Billiard-balls, and Wash-Balls, by the* EDITOR.

A METHOD of preparing and turning a truly spherical figure between two centres, principally upon a large scale, by means of the large wheel, commonly made use of by turners.

* From vol. XVII. of the Transactions of the Society for the encouragement of Arts, Manufactures, and Commerce. The Society voted the sum of twenty guineas to Mr. Cook for this communication.

Prepare a cube of wood, as accurately as may be; plane one side true, and guage a line down the middle of it, from which line, the centres at each end are found with a pair of compasses. Then shape the piece to an octagonal form, by taking off the four corners; next, place it in the lathe, and lay the band on about one third from the end of it; then turn or strike each end to the exact length of the intended diameter of the sphere. Afterwards, with a pair of compasses, divide the piece which gives the centre or curve line, and bisects the guage-stroke; strike it with a chisel, and then with a small gouge, which will make a groove for the band to work in, (taking care not to diminish the size of the diameter); next, from the middle of the piece, work down each end of it with a gouge, to as fair a round as you can with the callipers: then take the piece out of the lathe, and carefully prick the second centres, which the gauge stroke and curve-line give: place the piece again in the lathe, by the last pricked centres, and pass it round by hand, working it down with a small firmer chisel, in order to form a second curve line, until it bisects the first diameter, or curve-line: then strike the piece to the first centres, and work off the remaining wood with a large firmer chisel, until it becomes flush with the second curve-line: it may then be polished.

You may either throw off the band, and turn round the ball by hand, to work off the groove the band played in; or should you not think fit to pass the ball by hand, you may shift the rest to the opposite side of the lathe, and have the wheel turned the reverse way; by this means you turn off the groove. To polish the remainder of the sphere the band may be made to play on the surface of it, by being steadied with the hand.

Remarks by the EDITOR.—The ivory balls for billiard playing are carefully finished by hand, after the lathe has done its work, by means of flat steel plates, hardened and tempered, and having holes in them of various sizes, and

made truly circular, and the edges of the holes also being very sharp. In these holes the balls are worked in every direction, and scraped until all the protuberances are completely removed, and they become perfect spheres, after which they must be polished.

On forming perfumed Wash-balls into shape.

Whilst we are treating on the subject of forming globular bodies, it may not be amiss to mention that the perfumers shape their lumps of marbled and other soap into balls by means of a conical glass, resembling a wine glass, the brim of which has been ground accurately true and sharp upon a flat surface. The mass of soap being held in the left hand, the brim of the glass is worked over its surface in all directions, with the right hand, at the same time that the ball is turned every way by the left; the excess of soap is thus removed; and in this easy mode, are these regularly formed bodies made, the glass performing a nearly similar office with the circular holes in the steel plates, as applied to the finishing of the ivory balls.

XXIV.—*On the fallacy of the prevailing opinion, that a Candle burns away the faster for being snuffed.* By BENJAMIN BABINGTON, *Esq.*, M.B.

IT is a commonly received opinion, that a candle, when regularly snuffed, burns away much faster than when suffered to burn without snuffing; and hence people submit to the very great loss of light, occasioned by that neglect.

Mr. J. I. Hawkins, many years ago, made experiments, by which he proved, that a candle does not burn away the faster in consequence of being snuffed; and we are glad to find his experience again confirmed, by the following accurate experiments, made by Mr. Babington*.

He had six candles of the best tallow, cast in the same

* See his "Account of a peculiar vegetable product possessing the principal properties of tallow," in the Quarterly Journal of Science, Literature, and the Arts, No. XXXVIII.

mould, with wicks of twelve threads, these he burned for one hour, in an apartment in which the air was unagitated, and at a temperature of 55°. He first performed the experiment by snuffing them every ten minutes, and then without snuffing them at all; being desirous to ascertain what difference in the combustion, the snuffing would cause.

The following are the results:

Snuffing every ten minutes.

Weight in grains, when lighted.	After one hour.	Loss.
781	675	106
782	682	100
784	682	102
785	681	104
785	676	100
792.5	690	102.5

Without Snuffing.

Weight in grains, when lighted.	After one hour.	Loss.
673	573	100
676	573	103
676	570	106
681	581	100
681	580	101
689	592	97

It thus appears that the consumption of material in a tallow candle snuffed at intervals of ten minutes, is only 2.75 per cent. more, than in a candle not snuffed; *a difference very inconsiderable, compared with the difference of light produced.*

XXV.—*On collecting Rain Water for watering the Plants in hot-houses, green-houses, &c. By Mr.* WILLIAM SPEECHLY.

WE extract the following judicious remarks on readily collecting *rain-water*, and which is certainly most naturally eligible for the purpose of watering plants, from the au-

thor's excellent work "on the culture of the pine-apple, and the management of the hot-house."

On water proper for the Pine-apple plant.

The quality of the water used in the hot-house is of considerable importance. In many places, hot-houses are supplied with well-water, which is generally put into a cistern three or four days before it is used. Pond, or river-water is preferable, and is generally chosen for the above purpose, where it can be had with conveniency; but the supply that a hot-house requires is attended with much trouble and great expense.

It must be allowed that the water which falls from the heavens is preferable to any other: there is something in rain-water peculiarly adapted to promote vegetation. It seems to contain the food of plants, which it gets in its passage through an atmosphere loaded with putrescent particles.

All hot-houses may so easily be supplied with rain-water, that it seems strange an object of so much importance should hitherto have been so little attended to.

The water which falls on the roof of a hot-house is in most seasons sufficient at least for the pine plants contained in it; I say in most seasons, for the quantity collected from the dews in dry weather is almost incredible: whether it proceeds from the exhalation arising from the frequent waterings in the hot-house, in which case the same water may possibly be used several times over, or whether the great heat in the hot-house attracts the watery particles floating in the open air during the night, are points that I shall not take upon me to determine.

When a hot-house is building, by bestowing a very trifling additional expense, (which will save a continual one afterwards), the rain that falls on the roof may be brought into a cistern placed in any part of the building.

When this is intended, it will be necessary to have a

course of stone project in front nine inches beyond the wood plate that supports the roof; which stone should have a groove cut in the middle five inches in breadth, and the depth of the groove at the beginning should be half an inch, increasing one-eighth of an inch in every yard in length. This is a good proportion. The groove will receive the water that falls on the roof, and if worked in the above manner, the water will descend to one end of the stove if small; but if the hot-house be large, it will be more convenient to descend from both ends to the middle, where a semi-circular stone, one foot in diameter, worked in the form of a bason, should receive the water: this stone must have a hole cut at the bottom, into which a leaden pipe should be fixed, which will take the water from thence to any part of the hot-house under the level of the stone.

The large hot-house at Welbeck is thus contrived; so that all the rain that falls upon its roof, which contains above three thousand square feet, is brought at pleasure into a large cistern in the front bed in the middle of the stove.

I should have observed, that the groove in front is covered with lead; likewise, that there is a waste-pipe in the cistern to take off the water when the cistern is full; also, that a small plug prevents the water from coming into the cistern, when not required; and, that the cistern is sufficiently large to contain a reserve of water against dry weather.

XXVI.—*On Covering and Glazing Hot-houses, Green-houses, &c. From the same work.*

THE covering of the glasses in a hot-house is not absolutely necessary, even in our severest seasons: yet where the whole of the glasses are covered during the winter nights, much less fuel is required than in other hot-houses where

there is no such convenience: however, the saving in fuel is far from being adequate to the expense attending the covering; for besides the first expense of the covers, and the daily one in putting them on and taking them off during the winter season, we find, by experience, that more glass is broken thereby than by every other accident. But here it may be said, that glass is also frequently broken in hot-houses that are not covered, by the severity of the weather: this I grant is often the case when the squares of glass are large, and when the glazing-work is injudiciously performed. We know that thin window-glass (such as is used for hot-houses) is an elastic body, and that its elasticity increases and decreases in proportion to the temperature of the air.

The method of glazing in lead is now exploded; and what glaziers term *slate-glazing in putty* is most generally adopted.

When squares of glass are cut of a large size, they are generally cast or warped; therefore it is a practice with glaziers to tack them down with small tacks or sprigs, in order to make the work look neat. The glass bears this confinement during the time the weather is warm, but in a hard frost the squares so strained frequently break.

The squares for a hot-house, where covering is not intended, should not be larger than eight by six inches, and the groove in the wood to receive them should be five-eighths of an inch deep, which will admit of their being put in without straining them in the least from their natural form; they will then withstand the severity of the weather without danger. Added to this, there is a great saving in point of expense, by having the squares of glass of so small a size, for the price of glass varies according to the different size of the squares: besides, as each square, when put in with putty, has a bearing on two sides only, small squares must consequently be the strongest, and therefore the less liable to be broken.

In this place I must not omit taking notice of the common erroneous method of putting in the squares of glass, which is to let them lap over each other at least an inch, and in some hot-houses an inch and a quarter; whereas three-eighths of an inch is found quite sufficient to keep out the rain that falls on the house, which will not only make a saving in glass, but is better in other respects; for the cavity between the squares soon gets filled with dirt, and so broad a space between each square being darkened contributes to give the house a gloomy appearance. Besides, the water that lodges between the squares in the winter is apt to freeze, in which case it expands, and thereby frequently causes the squares to break.

As glass is now become the principal object in point of expense in the building of a hot-house, I flatter myself that what I have advanced on this head, will not be esteemed an unnecessary digression.

Many small hot-houses have for their covering a large sheet of canvass, which, by the help of a roller and pullies, is moved up and down with great ease. This is an expeditious method of covering, and may be of great use on the approach of a large hail-storm: though instances of damage done this way rarely occur.

But where hot-houses are large, this mode of covering cannot so well be adopted; therefore the most general method is to use light covers of wood, or frames of wood covered with painted canvass. The covering the whole of the roof of a hot-house in this manner is very troublesome, and attended with great expense; nor indeed is it absolutely necessary, as I have observed above.

When either of the above methods are practised, it should be done with discretion. In many places the covers of the hot-houses are sometimes, in a snowy, dark, severe, or rainy season, permitted to remain on for many days together, which is very detrimental to the plants, as they will in time draw themselves weak by the continuance of

such a practice: for it is observable, that plants grow much faster in the dark than in the light; and this is manifest from the progress of plants when first they arise from seed, in the open ground, in the spring of the year, when they do not grow half so much in the day as in the night. But here it must be observed, that the sun and light give maturity to the nightly progress of plants, and the want of them soon causes the plants to grow languid, weak, and in time to die.

LIST OF PATENTS FOR NEW INVENTIONS, *which have passed the Great Seal since June 28, 1825.*

To Jean Jacques Saintmarc, of Belmont Distillery, Wandsworth-road, Vauxhall, in the parish of Saint Mary, Lambeth, in the county of Surrey, distiller; for improvements in the process of, and apparatus for distilling, Dated June 28, 1825.—To be specified in six months.

To David Redmund, of Agnes Circus, Old-street-road, in the county of Middlesex, engineer; for certain improvements in building and constructing ships, houses, and other buildings. Dated June 28, 1825.—In six months.

To George Tompson, of Wolverhampton, in the county of Stafford, gentleman; for an improvement in the construction of riding-saddles. Dated June 28, 1825.—In six months.

To John Heathcoat, of Tiverton, in the county of Devon, lace manufacturer; for certain improvements in the method of manufacturing of thrown silk. Dated July 6, 1825.—In six months.

To William Heycock, woollen cloth manufacturer, of Leeds, in the county of York; for certain improvements in machinery for dressing and finishing of cloth. Dated July 8, 1825.—In six months.

To John Biddle, of the parish of Donnington, in the county of Salop, glass manufacturer; for a machine, or combination of machinery, for making, repairing, and cleansing roads and paths;

which machinery or parts of which machinery is or are applicable to these and other useful purposes. Dated July 8, 1825. —In six months.

To Molyneaux Shuldham, of Brampton-hall, Wrangford, in the county of Suffolk, lieutenant in the royal navy; for certain improvements for the purpose of setting, working, reefing, and furling the sails of boats, ships, and other vessels. Dated July 8, 1825.—In two months.

To William Furnival and John Craig, both of Anderton, in the county of Chester, salt manufacturers; for certain improvements in the manufacturing of salt. Dated July 8, 1825.—In six months.

To John Day, of the town of Nottingham, lace manufacturer; and Samuel Hall, of the same place, lace manufacturer; for an improvement on a pusher-twist or bobbin-net machine. Dated July 8, 1825.—In two months.

To Walter Hancock, of King-street, Northampton-square, in the county of Middlesex, jeweller; for an improvement or improvements in the making or constructing of pipes or tubes, for the passage or conveyance of fluids. Dated July 16, 1825.—In six months.

To William Hirst, manufacturer; and Henry Hirst, manufacturer; both of Leeds, in the county of York; for certain improvements in scribbling and carding sheeps-wool. Dated July 16, 1825.—In six months.

To Henry Hirst, manufacturer; and George Bradley, machine-maker; both of Leeds, in the county of York; for certain improvements in the construction of looms, for weaving woollen cloths. Dated July 16, 1825.—In six months.

To Thomas Wolrich Stansfield, merchant; William Prichard, civil engineer; and Samuel Wilkinson, mechanic; all of Leeds, in the county of York; for improvements in looms, and in the implements connected therewith. Dated July 16, 1825.—In six months.

To Thomas Musselwhite, of Devizes, in the county of Wilts, saddler and harness-maker; for certain improvements in the manufacture or construction of collars for horses or other animals. Dated July 26, 1825.—In two months.

To Mark Isambard Brunel, of Bridge-street, Blackfriars, in the city of London, esq.; for certain mechanical arrangements for obtaining powers from certain fluids, and for applying the same to various useful purposes. Dated July 16, 1825.—In six months.

To Thomas Sitlinton, of Stanley Mills, in the county of Gloucester, engineer; for certain improvements in machinery for shearing or cropping woollen or other cloths. Dated July 16, 1825. In six months.

To Joseph Farey, of Lincoln's Inn Fields, in the county of Middlesex, civil engineer; for improvements in lamps. Dated July 16, 1825.—In six months.

To Thomas Robinson Williams, of Norfolk-street, Strand, in the county of Middlesex, gentleman, (being one of the people called Quakers); for an improved lancet. Dated July 16, 1825. —In six months.

To Thomas Cook, of Upper Sussex-place, Kent-road, in the county of Surrey, lieutenant in our royal navy; for improvements in the construction of carriages, and on harness to be used therewith, whereby greater safety to the persons riding in such carriages, and other advantages, will be obtained. Dated July 16, 1825.—In six months.

To Joseph Chesseborough, dyer, of Manchester, in the county of Lancaster, merchant; who, in consequence of a communication made to him by a certain foreigner residing abroad; is possessed of a certain invention of a method of conducting to, and winding upon spools or bobbins, rovings of cotton, flax, wool, or other fibrous substances. Dated July 16, 1825.—In six months.

To William Hirst, gentleman; and Joseph Carter, cotton-spinner; both of Leeds, in the county of York; for an apparatus for giving a new motion to mules or billies. Dated July 16, 1825. —In six months.

To John Palmer De Lafons, of George-street, Hanover-square, dentist; for an instrument for extracting, and method of fixing teeth. Dated July 16, 1825.---In six months.

To Jonathan Downton, of Blackwall, in the county of Middlesex, shipwright; for certain improvements on machines or pumps. Dated July 19, 1825.---In six months.

THE

TECHNICAL REPOSITORY.

XXVII.—*Specification of the Patent, granted to* EDWARD CHARLES HOWARD, *of Westbourn Green, in the county of Middlesex, Esq.; for a Process for preparing and refining Sugar.* Dated October 31, 1812.

I THE said Edward Charles Howard do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained as follows; that is to say: from the known fact that water dissolves the most uncrystallizable sugar in preference to that which is most crystallizable, and also upon a discovery I have made that no solution of sugar in water can, (unless already highly concentrate), without material injury to its colour and crystallizing power, or to both, be exposed to its boiling temperature during the period required to evaporate such solution to the crystallizing point, I have established and adopted the following operations:

In the first instance, I do submit raw or muscovado sugar to a primary operation, by well mixing, as expeditiously as possible, the said sugar with such a quantity of water as will, at the common temperature of the atmosphere, bring it to a magma of the consistency of well-worked mortar; and I do leave the same at rest for the space of an hour or more, and I then heat the same to a moderate temperature, by preference from 190 to 200 degrees of Fahrenheit's scale, which is best and most conveniently to be effected in a vessel surrounded by boiling water or steam, under the common pressure of the atmosphere, which apparatus is too well known under the name of a water-bath to require a particular description; and,

having brought the said mixture of sugar and water, by the said means, and by stirring, up to a uniform temperature, I do then regulate, if necessary, the consistency thereof by the addition of more sugar, or a thinner magma, as may be requisite in order to put the mass into such a state of imperfect fluidity, that the same shall readily close behind the stirrer; and I do fill the moulds therewith immediately from the water-bath, by any convenient means; and after suffering the whole to become cold in the moulds, as is usual when sugar has been boiled and filled in the common method, I do take the stopper out of the mould, and suffer the melasses to drain therefrom, and so soon, or somewhat sooner, as the drainage has taken place, I do pare down the larger or upper surface of the lump, or loaf, or mass of sugar remaining in the mould, with any convenient instrument, until I find the sugar presents a uniform appearance; and I do mix the sugar so pared off from the said lump, or loaf, or mass, with cold water, to a magma of such a consistency as that the same shall not readily close behind the stirrer; and I do replace it in that condition upon the uniform and firm surface so prepared as aforesaid, and so soon or immediately as the magma becomes moderately dry, I do carefully pour thereon, with the intervention of a float, or similar guard or defence, a cold saturate solution of fine sugar in cold water, about half an inch deep: or otherwise I do, by preference, take off the same magma down to the surface of the lump, or loaf, or mass, left after the first paring as aforesaid; and I do re-mix the same with water, to a thinner consistency than last mentioned, and do again replace it as aforesaid, and do repeat the said operations by thin magma, or with a cold saturate solution of finer sugar than that which is intended to be refined, according to its nature or quality; and do farther declare that when the sugar proves extremely close grained, and the surface extremely hard, an unsaturated solution of sugar, or even water itself, may be poured thereon without running in, but I by no means recommend such procedure,

because the same does require too much nicety for general practice.

And I do farther declare, that when the sugar proves open grained, the finer the sugar made into magma is ground the better, because the moisture is thereby prevented from descending too fast or unequally into the loaf.

And farther, that it is by no means necessary that the identical sugar taken from the surface of the loaf should be used as magma or syrup thereon; but, on the contrary, that it is more convenient for saving time, or in other respects, to use a sugar of equal or finer colour, in like manner obtained from some former operation.

And I do ascertain the fit time for terminating the said primary operation either by drawing from time to time one of the lumps, loaves, or masses, so prepared, or by observing the greater or less freedom with which new moisture is admitted, and the colour of the melasses dripping out; which last is in most cases a sufficient criterion of the degree of purification which has taken place. And, as far as is consistent with convenience and economy of heat, I declare it to be most beneficial to lower the temperature of the floor or apartment in which the moulds are placed, previous to their being treated with the magma, to about 60 degrees, and again to raise the same, to about 80 or 90, after the surface of the loaf becomes dry for the last time. And that, in all and every case of the percolation of melasses or syrup, as before or hereinafter described, it will be needful to pierce, perforate, or break the dry surface of the mass of sugar in the moulds, whenever the same shall become so solid or iced over as to prevent the access or escape of the air into or out of the sugar, and thereby to impede or prevent the flow of the said melasses or syrup.

The first part of my process being thus terminated, I do in the usual manner knock or draw out the lumps, loaves, or masses, and separate what is termed the net or good sugar from that which retains melasses, keeping

the latter to be mixed up with raw sugar, for a subsequent preparatory operation, as before described; and the former I do proceed to refine by pouring upon it, in any convenient vessel, six pounds of water (by preference boiling hot) to every five pounds of sugar, deducting about six *per cent.* for the moisture previously contained therein, (somewhat more or less, not being very material,) and after having insured a perfect dissolution of the sugar, by stirring, I do suffer the dirt and gross and insoluble impurities to subside, and I then draw off the solution by a cock, or other convenient means, from the said impurities into another cistern or suitable clean vessel; and do then effect the clarification and separation of further impurities and colouring matter by the addition of my ordinary or common finings, which I prepare as follows. I do slake well-burned lime with boiling water, and prepare a cream of lime; and when the same has become as uniform as the nature of the lime will admit, I add about an equal bulk of water thereto, and do then cause the mixture to boil for some minutes, until the lime assume the appearance of fine curd; and I do separate the extraneous matters and lumps, which are always contained in lime, by washing over, or, as it as been termed by chemists, the process of elutriation; and in order to insure the more effectual separation of any lumps, I do pass the lime and liquor so washed over through as fine a sieve as will give passage to the finest of the curds. And in the next place I do take about two pounds and a half of alum for every hundred weight of solid sugar intended to be refined, and I dissolve the alum in sixteen times, or thereabouts, its weight of water, (by preference boiling hot,) and add to such solution about seventy or eighty grains of whiting for each pound of alum; and after stirring up the said mixture until effervescence ceases, I allow the suspended substances to subside, and do draw off the solution from the precipitated matters, and I then put into it the prepared lime curds shook up with the water

they retain, and do agitate the whole during the affusion, in such quantity or proportion of the curds as that paper stained with turmeric shall barely change its colour by immersion in the mixture, and shall recover its former yellowness when dry, and shall, by immersion in the clear supernatant liquor thereof, after subsidence, be scarcely changed at all. By these means the finings are duly prepared, and I do suffer the same to settle to the bottom of the containing vessel; and I do, after drawing or decanting off the supernatant liquor, place the said finings upon a blanket, supported in the manner of a filter, and allow the moisture to drain off until the mass begin to contract, and separate by cracks therein; and in this last state the said finings are fit for the clarification of the solution of sugar last drawn off, as above described. And I do add by degrees, and with stirring, such a quantity of that solution, or of any other like solution of sugar, as will bring them to a uniform creamy state. And I do then pour such mixture into the whole quantity of the said solution of sugar, prepared or intended for clarification as aforesaid, with sufficient agitation to diffuse the finings equally.

The refined or clarified sugar is then suffered to repose either during the night or for about six hours, more or less, and the bright liquor then drawn off or decanted from the finings, according to the well-known methods, and an evaporation is commenced and carried on at the temperature of about 200 degrees, more or less, which, as aforesaid, is best effected by the heat of steam, or water under the common pressure of the atmosphere, until the hot liquor shall have acquired a specific gravity of about 1,37, more or less, (water being considered as 100,) and in this state I transfer the same to any convenient vessel, and stir it frequently, until it have assumed the proper granular consistence to fill the moulds; and at the said consistence I do fill my moulds therewith. I do then take out the stoppers from the moulds as soon as they become cold, and allow the syrup naturally con-

tained in the lump, loaf, or mass, to run therefrom in the usual manner; and during the said operation, or, when the syrup has left the upper surface of the lump, loaf, or mass, I do examine the same, and pare it down, as before described; and if the sugar appear sufficiently fine for the intended consumption or market, I do, after it ceases to drip, take it out of the mould in the usual manner, and cut off the smaller end of the loaf not clear of syrup; and I do then dry it in the accustomed manner. But in case the lump or loaf be not sufficiently white, I do then, as before described, mix up that sugar, which I before pared off the surface to a magma, with water, as hereinbefore described, in my primary operation.

And farther, supposing the loaf, as above prepared, not to be sufficiently dense or close in its grain to meet the eye of the consumer, I do, previous to drying, remould the loaf in a manner well known, and in common practice, by stamping the grains into a metallic or other mould, which will immediately redeliver the same.

And farther, supposing it to be required to keep or retain the point of the lump, loaf, or mass, without returning the syrup contained in that point upon the body thereof, I do effect this desideratum by the appendage of a pipe, of sufficient size or continuation of the bottom of the mould, to be applied and fixed to moulds of the usual construction, having the aperture enlarged to one inch at the least, or to form part of a new mould, to be fabricated on purpose; and I do take off the lower portion of the sugar, which will be contained in the said pipe, along with the redundant syrup, instead of taking off the point as usual.

I now return to the liquors left in the two cisterns, or other vessels, the one containing the gross dirt and insoluble impurities, and the other containing the finings as above described (the solution of sugar contained in both being necessarily to be worked up in the next or some subsequent operation.) To the first of the said liquors I

add about its bulk of boiling water, and do then make it pass through a cloth sufficiently close in its texture to retain the gross impurities; and I do add the other liquor, containing the finings, and do then abstract therefrom, by washing and subsidence, all the sweet they contain, which sweet liquor I use for magma, or, (allowing for the sugar it contains,) instead of beginning the purifying process with water, as above described. And as to the syrups which drain from sugars which have been subjected to the action of my finings, the same may be evaporated without any addition, provided care be taken to avoid the boiling temperature thereof, which is best effected by the steam or water-bath as aforesaid, and such syrups will, by such treatment, afford strong crystals a second or third, or even a fourth time. Or otherwise, sugar remaining from top parings, cut-off points, or any other remnants, may be melted in them, upon the water-bath, to bring the same up to their crystallizing density or granular consistency. And the inferior syrups may be advantageously mixed with muscovado sugar instead of water, as directed in my primary operation.

And I do farther declare, that the lumps, loaves, or masses of sugar which have been refined by the use and application of my ordinary or common finings, or any other sugars in a forward state of refinement, may be still farther refined by the use and application of other finings; and that the said last-named finings are made as follow: I take about three pounds and a half of alum for every hundred weight of solid sugar intended to be refined, and I dissolve the alum in sixteen times, or thereabouts, its weight of water, (by preference boiling hot,) and add to such solution about seventy or eighty grains of whiting for each pound of alum; and after stirring up such mixture until effervescence ceases, I allow the suspended substances to subside, and do draw off the solution from the precipitated matters; and I then pour into it (as and instead of the lime-curds in my ordinary or common fin-

ings) a concentrated solution or ley of caustic soda, until the agitated mixture shall produce a very slight stain upon turmeric paper; and I then add thereto the fairest water, and proceed to wash the precipitate, by alternate diffusion and subsidence, until the water come off tasteless, and I then draw off, decant, and drain the remaining water from the finings, as hereinbefore described. And with regard to fair water, I do often find it convenient to purify my water by the well-known process of boiling it with a small quantity of alum, and a little lime or chalk, taking care to leave no excess of caustic lime in solution.

And I do farther declare, that, in directing the use of alum, it is not because it is preferable to mere sulphate of alumine, but because alum, being already an article of commerce, can be more readily obtained. And I do declare, that a compound of lime and of alumine, similar to that hereinbefore described, would, howsoever obtained, answer the purpose of my first finings, and that pure alumine, howsoever obtained, would answer the purpose of my second finings. And as to the use of caustic soda, I do prefer its use to that of potash, because the salt resulting is most easily washed away, and to that of ammonia, because this last is an article of considerable price.

And farther, that I do produce the superior degree of refinement in solid sugar (already refined to a forward state) by dissolving the sugar so intended to be refined in the fairest water (by preference boiling hot) in the manner and proportion hereinbefore described. Subsequent to my preparatory operation, and immediately upon the solution being effected, I do mix and diffuse my said second finings as the first finings were hereinbefore directed to be mixed and diffused, and, after due clarification by repose, I proceed to the evaporation and subsequent completion of the sugar in loaves, as hereinbefore in like cases directed and prescribed.

And I do farther declare, that although, in the application of heat to the refining of sugars, in my said invention

or process, I have stated and mentioned the temperature of about 200 degrees of Fahrenheit's scale, as the heat most proper to be used and applied in order to secure and preserve the colour and crystallizability of the sugars, and most easily to be obtained with precision and uniformity by means of the water-bath or steam-bath, by me first used in refining sugars as aforesaid, yet that nevertheless, when circumstances or choice may render the same desirable, I do make use of higher temperatures (although less beneficial) taking care to preserve an uniformity in the application of the heat to the surface of the boiler. And farther, that for operations upon the water-bath or steam-bath, I do construct my apparatus according to the principles or methods of practice which are known and approved in chemical and other works; and that, for temperatures above the boiling point of water, I do make my steam-bath strong, capable of being properly closed, and do provide the same with a feeder under due pressure, or a forcing pump for feeding, and a safety-valve and pipes of communication, cocks, gauges, and all or any of the needful fittings-up which are commonly used with steam-boilers.

And farther, that although I do greatly prefer the water or steam-bath to any of the means of heating my vessels, yet I can, and do also, when required, carry my said process into effect by a common fire, taking care, in the management thereof, to apply the heat regularly and equally to the boiler, and at the proper degrees, as aforesaid, which will necessarily require more attention in the operator than would have been demanded in the operations by water or steam.

And farther, that in case it should be required to apply and use my ordinary or common finings first herein described to very coarse moist or deliquescent sugars, it will be necessary to add a greater proportion of the lime-curds than has been described and directed with regard to sugars partly refined by percolation or otherwise; and in making the said addition, the judgment of the operator must be

directed by the quality of the said coarse moist or deliquescent sugars.

And lastly, I do declare that my said invention, and the several parts, manipulations, or proceedings thereof, may be carried into effect and practice, either wholly or separately, without conjunction or in conjunction with the methods of refining sugars already in common use; and that the management thereof, the several proportions of materials or ingredients, the furnaces, vessels, or apparatus to be used, and the needful attentions to local and other circumstances, are all susceptible of variation according to the exigences of the respective works or operations, but that the same are either well known or may with facility be made or adopted from the instructions contained in these presents, by any competent workman, or other person or persons acquainted with the general course and nature of chemical operations.

Note.—We are desirous of calling the attention of our readers to the above valuable patent, as it expires in the course of next year.

XXVIII.—*Queries on the success of Mr.* WILLIAM SALISBURY'S *endeavours to introduce a better System of Manufacturing Flax in Ireland. By* R. W. GASON, *Esq.*; *with the* EDITOR'S *reply.*

SIR, *Richmond, Nenagh, Ireland, July 27, 1825.*

IN the 36th number of the Technical Repository, to which I am a subscriber, I find a letter from Mr. William Salisbury, on the subject of manufacturing flax without fermenting it; and also on the method pursued in the bridewell at Kingston-upon-Thames, in spinning and dressing it; dated from Brompton. Mr. Salisbury having stated that he was employed by the society established for improving the condition of the Irish peasantry, and that he resided for that purpose in Munster, during the last flax season, I took it for granted that any application to him on those subjects, which are of such importance to this country, would have

experienced immediate attention; nor can I yet abandon the idea, as any man placed in the situation he held must, from a sense of duty, consider himself bound to give any information connected with the subject on which he was employed, and which was purely of a public character. I am, therefore, willing to suppose, either that my letter has not reached him from a wrong direction, or that he may be absent on some other public undertaking. My object in now addressing you is to obtain your assistance in procuring such information as he may be able to afford on the process of manufacturing flax without water rotting, and also the system pursued in Surrey, to which he alludes. With respect to the machines used in the bridewell at Kingston, I was particularly anxious to know the cost of the three he mentioned, namely, the slivering frame, the roving machine, and the prison spinning frame; and where they were to be procured, and whether they were worked by hand power, or the intervention of machinery, either water, steam, or horses; likewise if they were capable of being attached to a tread-mill, a powerful one being lately erected in the gaol of this county, Tipperary. By referring to your 36th number you will find his letter, and, I trust, will excuse the liberty I take in giving you this trouble. The near approach of the flax season renders it most desirable that a speedy answer should be sent to these queries; and as I am satisfied every Englishman is anxious to contribute his stock of information and knowledge on any subject that may be of service to our wretched peasantry, I fondly calculate on receiving the assistance I seek, from both you and Mr. Salisbury. I have the honour to be, sir, &c. &c.

To T. Gill, *Esq.* R. W. Gason.

Remarks by the Editor.

Mr. Salisbury informs us that he had written two different replies to Mr. Gason's letter, expressing his disappointment at the ill success of his endeavours to introduce a better system of manufacturing flax in Ireland; but that he had

sent neither of them away, as he was fearful of committing himself, from the strong and indignant language in which, as was natural, he had mentioned the unworthy measures taken by certain interested parties in Ireland to thwart his endeavours. Nevertheless, that he had succeeded in manufacturing part of a piece of linen (the remainder being wantonly destroyed), which received the highest approbation of some of the most competent persons in this country, on account of its superior qualities; and he has lately written to Mr. Gason (for the third time), to say that he is still willing to make another endeavour to improve *the vicious system of manufacturing linen cloth* now carrying on in Ireland, provided an opportunity be afforded him.

It will hardly be credited that every possible means to injure the quality of the Irish linen seems to be most anxiously studied there. And we lately learn that, *in addition to the mischiefs occasioned by repeatedly steeping fresh parcels of flax in the same ponds,* (so ably pointed out by Mr. Gavin Inglis*, and which, of course, occasioned more labour to be necessary, and more powerful chemical means to be employed in bleaching out the *dye* so imparted to the flax), Dutchmen are now actually employed in teaching the Irish to cover the flax, whilst steeping, with the *black mud* lying at the bottoms of the ponds, by raking it over them with instruments made for the purpose!

We should almost be tempted to believe that this absurd practice was introducing by the Dutch with the politic view of still more effectually ruining the quality of the Irish linen, and consequently lessening its estimation in foreign markets. For themselves, the Dutch are now actually introducing a better and expeditious system of watering flax into their country†, *by continually adding fresh water to the flax every hour whilst steeping it, and withdrawing that which had remained upon it for that length*

* In the *Philosophical Magazine* for the year 1818; and re-published in the *Technical Repository*, vol. VI. page 328.

† See *Technical Repository*, vol. VI. page 381.

of time; and, in short, as nearly as possible, imitating that process which had produced the finest specimen of flax which Mr. Inglis, in his long experience as a bleacher, had ever seen, namely, *watering it in a mountain stream continually renewed.*

Mr. Salisbury substituted the use of a very simple and effectual machine, being an improved hand brake, in place of steeping the flax, and by this means preserves all its native strength. The late Mr. Lee also substituted machinery for water-rotting, with the same object in view, and with the most complete success. His useful labours, however, produced no beneficial results to himself or to his country; for, repeatedly foiled in his attempts, he died at length in distress, and before any considerable period had elapsed in the term allowed him by his patent, and the act of Parliament subsequently obtained, to conceal the specification of it for seven years.

In the mean time, the public loudly calls for some improvements to take place in the durability of our linen. It is is a well known fact that, as is now commonly the case, when clothing is made of a mixture of linen and calico, the latter will very frequently exceed the former in its durability.

We fear it will be long indeed, if ever it happens, that stocks of family linen will again, as formerly, descend as heir-looms from one generation to another; for, thanks to the water-rotting system and the chemical bleaching, our linen is now become a most desirable object in *a merchantable point of view,* where *a quick return,* arising from *its speedy decay,* is the grand *desideratum;* and whether it be owing to the prevalency of this spirit, or to the thraldom under which the tenants in Ireland labour, in being forced to have their flax scutched at their lord's mill, or from what other causes, we fear that no attempts to improve the quality of the Irish linen will at present succeed.

We well remember the time when the substitution of calico for linen would have been contemned on account of

the little durability of the calico. Now the case is completely reversed, and we actually know that *much pains are taken to divest flax of its native strength, its superior length of fibre, and its beautiful silky glossiness*; that, in fact, it is already *broken into a short staple*; and that attempts are now making in France to *cottonnise* it, or *remove its glossiness!*

We may here be permitted to remark, incidentally, on the impolicy of allowing the specifications of patents to remain concealed, as instanced in the case of Mr. Lee; who was so jealous of having it in his power to say that his invention was either this thing or that, knowing the fact could not be ascertained, that he suffered himself to be pirated upon continually, without ever bringing an action at law; which would have compelled him to expose his specification before the seven years allowed had expired. Nor, indeed, could he have recovered damages had he brought an action for an infringement, as the parties he proceeded against could know nothing of his invention from his specification, and therefore might have acted in ignorance that they were infringing upon his rights.

XXIX.—*On the Mineral History of Gold, and the separation of it from Earthy and Stony Bodies, by Water, Mercury, &c.* By the late WILLIAM LEWIS, *M. D.*

[*Concluded from page* 107.]

On the separation of Gold from Earths and Stones, by Mercury.

WHERE the minuteness of the particles of gold, and the weight of the matter with which they are intermixed, render them inseparable by water, quicksilver is called in aid for imbibing and detaining the gold. The gold sands freed by water, as in the foregoing article, from as much of the lighter matter as can be washed off by water, without endangering a great loss of the gold, are dried, and a small proportion, less than a hundredth part of their

weight of mercury poured on them: the whole is well kneaded up together, that the mercury may penetrate as much as possible into all the interstices between the grains; it imbibes the atoms of gold it meets with, and the sand is afterwards washed off by water.

In the Spanish West Indies, at those mines where the gold is imbedded in stones, and requires quicksilver for its separation, the stony matter is reduced to as fine powder as possible, that every atom of the gold may be laid open to the mercury. The powder is soaked for some time in a solution of common salt; the mercury squeezed out through a linen cloth, so as to fall like dew all over the surface of the cloth: and the mixture being well stirred and kneaded, a gentle heat is applied, by which the activity of the mercury is so far increased, that the incorporation of the gold with it, which, in the cold requires about thirty days, is said by J. Hernandez, in an essay on these mines, to be effected by this method in five or six days.

Alonso Barba, in the third book of his Art of Metals, describes another method, which he says he has practised with great advantage: he puts the powder, with a suitable quantity of mercury and water, into a deep copper vessel fixed in a furnace, and applies a fire sufficient to keep the water boiling; a small wooden mill assists the ebullition of the water in giving motion to the earthy powder, which continually rising and falling down again, is brought into frequent contact with the mercury at the bottom, so as to give out its gold to the mercury in as many hours as the common process, without heat, requires days.

When the gold is judged to be united with the mercury, the earthy powder is washed off by water, so as to leave the amalgam clean. Where the mercury has been kneaded up with the powder, a considerable part of it is always divided into such miuute globules, as to be washed away along with the earth; an inconvenience, which, in the other method does not happen, or in a far less degree.

On the separation of Gold from the sweepings of Goldsmiths' and Jewellers' Shops.

The gold dust, or filings, dispersed through the sweepings of the goldsmiths' shops, are recovered by amalgamation with mercury. Two broad iron bars, rounded at their ends, placed cross-wise, and fixed on an upright axis, are made to turn, by a handle at the top of the axis, on an iron plate fitted into the bottom of a tub*. The sweepings being put into the tub with a quantity of mercury and water, the powder passing successively under the iron bars, is ground and brought into contact with the quicksilver, which by degrees extracts the gold; while the water, which, after a certain time, is suffered to run off through a small quill, fixed in a hole made in the side of the tub, carries with it the lighter earthy matter†: fresh water is supplied till all the earth is thus washed off. The operation might doubtless be expedited by the use of heat, as in the above process of Barba.

The gold being by these means transferred into the mercury, and the mixture washed clean, as much as may be of the mercury, is pressed out through leather, and the remainder forced off by fire. To collect the exhaling mercury, a head and receiver are fitted to the iron pot, in which the mass is exposed to the fire: Barba advises the pot to be lined with a mixture of clay and sand, to prevent the gold from adhereing to, or dissolving a part

* Three of these mills are now used together, a bar of wood with holes made through it, which receive the three handles into them, giving motion to all the three mills, which are placed in a straight line, at once. The late Mr. Nicholas Paul informed the Editor that a mill was established at Geneva for washing the goldsmiths' and jewellers' sweepings *gratis*. It consisted of a flat circular ring of cast-iron, placed horizontally, and having a circular groove or channel, in which two heavy cast-iron runners were made to turn by the power of horses. The sweepings being put into the channel with mercury, water was made to enter the channel on one side, and pass off on the other side continually during the action of the machine. We said the proprietors professed to grind the sweepings *gratis*; but, in fact, the water carried off with it into proper receptacles, placed in an adjoining room, so much gold, as to render the concern *a highly lucrative one*. If we are not mistaken, a similar machine is, or at least was, established by foreigners in London some time since.—Editor.

† And possibly some of the gold also; see the foregoing note.—Editor.

of the iron, in case the fire should be raised so far as to make the gold melt*.

It is scarcely to be expected that the greatest address of the workmen can collect, either by water or mercury, the whole of the gold diffused through a large quantity of other matter, at least when the mercury is used, as it is in the large way, in so small a proportion as a 100th or 200th part of the weight of the earthy powder. Reaumur, after having worked some gold-sand with mercury, in the methods commonly practised by those who wash the sands of rivers, obtained from the remaining sand, by treating it with a double quantity of mercury, near as much gold as he had done the first time.

On the extraction of Gold, intimately combined in the composition of Sands.

For extracting gold from the ferruginous sands, mentioned in the preceding part of this article, the sand is to be made red-hot and quenched in water, and the ignition and extinction repeated four times, or oftener. The colour changes from yellow, red, or black, to a reddish brown. In the first and second heating the sand yields a slight smell, somewhat like that of garlick, a mark of its containing arsenic: at the third time the arsenical smell is scarcely to be perceived; but on throwing into the crucible a little tallow, or other like inflammable matter, it becomes stronger than before: this remarkable circumstance is by no means peculiar to these sands, for there are several arsenical minerals which give little of their arsenic in the fire, till some inflammable matter is added. The sand thus calcined, is mixed with twice its weight of granulated lead, and equal its weight of black flux; the mixture put into a crucible, and covered with some sea-salt, dried over the fire until it has ceased to crackle. The crucible is placed in a good blast-furnace, the fire strongly excited, and the

* This advice of Barba is adopted in the Royal Mint, in the *cast-iron crucibles* used for melting gold and silver in, with great economy.—Editor.

matter stirred from time to time with an iron rod; the fire must be urged till the scoria flows thin as water, which is known by the rod coming out almost clean, without the least knob sticking to the end of it. The crucible is then suffered to cool, and broken for getting out its contents: on the top is the common salt in a distinct cake, under this a shining black, compact, vitreous scoria: and at the bottom a lump of lead, easily separable from the scoria. The gold contained in the sand is now transferred into the lead, and may be separated by working off the lead upon a cupel or test. These sands contain also silver, which here accompanies the gold, and which may be parted after the cupellation, either by *aqua-fortis* or *aqua-regia*, according as the one or the other metal appears to prevail in the mass. This is the process followed by M. Lieberecht, in the assays already given an account of.

As the black flux (which consists of one part of nitre, and two or three of tartar mixed together, and burnt in a covered vessel to a black alkaline coal,) is apparently too expensive to be employed for any considerable quantities of the mineral, its place may be supplied by a mixture of potash, or other fixed alkaline salts, with powdered charcoal. Four parts of potash, three of charcoal, and thirty-two of lead, are sufficient for sixteen of the calcined sand. This mixture, as Hellot observes, requires the fire to be continued longer than the preceding, to make the matter equally fluid, but when it is made so, the yield is found to be in both cases alike.

The same end may be obtained also, by boiling the calcined sand in melted lead, without any inflammable or saline addition. For the vitreous matter, into which the lead is gradually converted, will dissolve the earth, and the unvitrefied part of the lead will receive and collect the gold; but amuch larger quantity of lead is requisite in this than in the other ways.

In all the foregoing methods, though the quantity of gold obtained is considerable, much still remains in the

scoriæ, for want probably of a thorough commixture of them with the lead: for whatever degree of fluidity the scoriæ are brought to, the particles of gold are too minute to subside by their own weight, and the lead can collect them only from those parts which it comes in contact with. It may therefore be presumed, that the separation will be the more complete, as the commixture of the lead is the more perfect. Lead cannot be mixed perfectly with sands but in a vitreous or semi-vitreous form. By grinding the calcined sand with litharge or other calces of lead, and exposing the mixture to a moderately strong fire, they may be intimately united into an uniform glassy compound, the sand being dissolved by the vitrefied lead, nearly as salt is dissolved by water. On adding to this compound a little powdered charcoal, or barely stirring it with an iron rod, the lead revives, and falls to the bottom; and as the sand has there been in contact with every part of it, the gold will probably be extracted from every part, at least more effectually than by the other methods. In this way, it will be proper to mix some alkaline salt with the litharge and sand; partly to promote the dissolution of such portion of the sand as floats on the top of the ponderous metallic preparation, and partly to continue the fluidity of the scoria, after the revival of the lead. The crucible may be made of Stourbridge clay, which seems to be one of the best of the common materials for resisting glass of lead in fusion. It appears to have been on a process of this kind, that Becher's proposition to the States of Holland was founded, for extracting gold with profit from common sands; it is plain from his account of the affair, in his *minera arenaria*, that he vitrefied the sand with glass of lead, or litharge; and he expressly mentions in one place, the precipitation of the lead from the glass by iron: he used also an addition of silver in great proportion for imbibing the gold, and thus required a vast capital for establishing a work in large; but where the lead is to be revived, the silver is rather detrimental than

useful; for the gold and silver contained in the sand are imbibed by the lead, and the additional silver occasions an enormous expense of *aqua-fortis* for dissolving it, in order to the separation of the gold. Whether, with this reduction of the expense, of which Becher himself seems to have had some idea, the process might be practicable to advantage, or whether some earthy bodies might not be an useful auxiliary for promoting the fusion of the gold sands, may deserve further inquiry: one kind of earth is frequently observed to bring another into fusion, though both are of themselves unfusible; and the earthy parts of different ores are made fluid in the furnace of the smelter by the addition of other earths.

On the extraction of Gold from the Ores of other Metals.

When gold is intimately combined with other metals in their ores, the ore is to be run down in the same manner as the same kind of ore without gold. The gold commonly melts out with the proper metal of the ore, from which it may be afterwards separated by different processes, according to the nature of the metal. There are grounds to believe, that most metalline bodies, as extracted from their ores, contain generally a portion of gold, though rarely sufficient to bear the expenses of its separation.

Zinc, arsenic, and mercury, are obtained from their ores by a kind of sublimation: hence, if the ores of these contain gold, the gold is to be sought for, not in the metallic substance separated, but in the remaining matter. There are some other cases also, in which the gold, instead of accompanying the metal in its fusion, is thrown off in the slag; but the ores and slags of this kingdom have been so seldom examined for gold, that I can say but little satisfactory on this subject.

XXX.—*Description of a newly combined Brass-founders' Forge-hearth and Steam-boiler.* By Mr. JOHN CALLAHAN, *Lamp-manufacturer, Gas-fitter, &c. Exeter-street, Strand.*

WITH A PLATE.

MR. Callahan was formerly in the employ of the late Mr. George Penton, of New-street-square, one of the earliest and most celebrated makers of the argand lamps; and the apparatus we are about to describe will prove the best testimony of his skill, and the successful manner in which he has availed himself of the present improvements in science to produce a combination of advantages and conveniences not only highly useful in his own peculiar line of manufacture, but also equally applicable to many other branches of business; and the very liberal manner in which he has kindly permitted us to avail ourselves of the fruits of his experience, by giving a full detail of the construction of his hearth and steam-boiler, and their various employments by himself, cannot be too highly appreciated by the public; and is a proof how much he sacrifices of his own individual good for the promotion of the benefit of the community.

Mr. Callahan is a member of the Society for the encouragement of Arts, and a constant attendant upon its committees of mechanics, chemistry, &c.; and he was not long in availing himself of such part of Mr. Franklin's self-acting feeder, for supplying high-psessure steam-boilers with water*, as was applicable to his purpose, divesting it, at the same time, of those parts which, although highly useful in particular cases, added an unnecessary degree of complexity to it in his instance; in fact, that part of it which he has retained is comprised within the limited space of four inches, that being the diameter of the aperture into the boiler, or the man-hole, as it would be termed in steam-boilers of greater magnitude.

* Rewarded by the Society, and published in its XLII. Vol. of Transactions; and also in the *Technical Repository*, Vol. VII. page 200.

Mr. Callahan's steam-boiler is only fourteen inches long, and eight inches wide and deep; it is made of copper, strongly rivetted together, and is supplied with water by a pipe proceeding from a vessel placed about nine feet above it; and, besides Franklin's feeder, it is also provided with the usual pressure and vacuum valves, gauge-cock, &c., as well as with pipes for leading the steam to a work-shop above, where it is used with great convenience for heating water, bronzing-liquids, &c.; or to use it below, and to suffer it to blow through hollow bodies, such as argand lamps, pillars for gas-lamps, tubes, &c., so as to heat them uniformly in the space of a minute, or even less, in order to lacquer them, and which, indeed, was the chief motive which led Mr. Callahan to the employment of it in his business: although he derives other advantages from it likewise, such as obtaining a constant and immediate supply of hot or boiling water, when necessary; as, for instance, in *finisking* the *dipping* or *pickling* of his brass work in *aqua-fortis*; as although, during that operation, the work is alternately dipped, first into the acid and then into *cold* water, until the proper effect is produced, yet he finds it desirable to dip it at last in *hot* water, *in order to give it such a degree of heat as shall cause it to dry quickly when plunged into and covered with saw-dust*, and thus avoid its becoming stained or tarnished previous to lacquering it; an object of considerable importance in the beautiful works of art now executed in brass, with a taste and skill which render them formidable rivals of the exquisite *or-molu* works, for which the French have so long been famous.

Mr. Callahan's forge-hearth does not differ much in its construction from others; it is in its combination with the steam-boiler that its peculiar merit consists. It will be seen on referring to plate V., that the cast-iron plate of the hearth is placed on a level with the bars of the fire-place under the boiler; that the fuel lies partly in the wrought-iron pan of the forge-hearth, and partly upon the

plate, being kept in place sideways, between two moveable cheeks of wrought-iron. It will also be seen, that an iron register-plate hangs in front of the end of the boiler, suspended by a counter-weight, and is capable of closing, more or less, the passage leading to the furnace under the boiler; and that there is a door to the ash-pit of the furnace below, as well as another door above opening into the flue of the chimney under the hood of the forge. The pipe leading from the bellows, (which are fixed above the hood, so as to be more out of the way in the work-shop,) does not enter the pan of the forge-hearth, but is fixed opposite to the hole in the pan, through which the blast enters the fire, leaving a space of half an inch between the end of the bellows-pipe and the pan, so that when the latter becomes heated in a high degree, as it does when brass is melted in a crucible in the forge fire, for the purposes of founding or casting small articles moulded in sand, for making solder, &c., the bellows-pipe does not suffer in the least thereby. In this disposition of things, Mr. Callahan finds that a fire supplied with *gas-coke*, an article generally difficult to manage, will, after being kindled in the morning, frequently continue alight all day, supported only by the air passing horizontally through it in its way to the chimney; the door of the ash-pit being then closed, and the register-plate let down upon the surface of the coke, it thus keeps the water in the boiler constantly heated, the hot air from the fire circulating under and around it; and when it is wished to raise the steam in the boiler to its proper height at any time, it is only necessary to excite the fire by shutting the upper door; or where a greater force of steam is wanted, to push some of the burning coke under the boiler, and opening the door of the ash-pit, the steam then very soon becomes of an extraordinary degree of force; and when it has performed its office, the fuel is again withdrawn from underneath the boiler, the ash-pit door closed, the door under the hood opened, and the register-plate adjusted as before described; and the

fire continues to burn in its usual gentle manner, ready for use in an instant, and at an expense of very trivial importance, when compared with that of other fuel, as charcoal for instance; and affording a fire excellently adapted from its strength, when urged by the bellows, and the solidity and cleanliness of the fuel, deprived as it is of both flame and sulphur, from the manner in which the coke has been formed, to the purposes of soldering, and particularly from it not giving way under the article laid upon it, as charcoal soon does.

In lacquering solid articles, Mr. Callahan formerly employed the usual lacquering stove, consisting of a cast-iron plate, laid upon a fire-place, and flues formed in brick-work, and requiring a considerable expense in fuel to heat it; besides the necessity of frequently having to wait whilst the fire was lighted, owing to its having gone out, it not being constantly open to view, as the fire on his forge-hearth is. Whereas now, he has only to place a cast-iron plate over the forge-fire, resting upon the two iron cheeks, and he very soon heats it to the proper degree by the help of the bellows. His fire is also always ready to heat his soldering-irons (or rather coppers) for soft soldering, his ladles with solder in them, &c. &c.; and, in short, he would now hardly be able to manage his business with comfort, without the help of *his combined forge and steam-boiler*.

The door leading into the chimney flue above, under the hood, serves to carry off any noxious fumes from the forge-hearth into the chimney, and to ventilate the work-shops. We have already observed, that Mr. Callahan judiciously pickles his work and bronzes it in *an upper workshop*, this is also well ventilated, so as to allow the nitrous gas and noxious acid vapours to escape freely into the open air; and not, as usual, when the pickling is performed in the cellar, to arise and enter the work-shops, to the very great annoyance of the workmen, and doing great injury to the work also. It would, however, have been very

inconvenient for him to have been obliged to convey hot water to his upper shop, or to have heated his bronzing liquids there by any other method than steam: the cold water vessel is likewise placed in the pickling shop ready for use there, as well as to supply the steam-boiler below, as above mentioned.

Reference to the Plate.

In plate V. fig. 1 is a front view, and fig. 2 is a side view or section of the forge-hearth and boiler; *a* the cast-iron plate, with a raised border in front of it; *b* the wrought-iron fire-pan; *c* the pipe leading from the bellows; *d* the orifice in the side of the pan to admit the blast; *e* the hood of the forge, built as usual upon a curved flat iron bar, the ends of which are let into the walls; and it is besides supported by an iron rod, which is hung or affixed to a beam above, and passing through the flat iron bar, is secured by a screw and nut; *f* is the lower door leading to the ash-pit of the furnace *g*; *h* the upper door, shown by dotted lines, under the hood; *i*, fig. 2, the furnace bars, placed on a level with the forge-plate *a*; *j* the furnace; *k* the boiler, resting upon the two side walls of the furnace, and its back end approaching within two inches and a half of the back of the chimney-flue *l*; *m* is an iron plate, having a gap in it which exactly fits the end and part of the sides of the boiler, and being let into the end and side walls of the furnace, it compels the heated air, after passing under the boiler, and arising at its end, again to return on each side of it, and to escape into the chimney over the top of the boiler, through the aperture left between the end of the plate *m*, and the iron plate *n*, which closes the front of the flue exactly, and also fits the top of the boiler. The flue is nine inches in depth and fourteen inches wide; and the boiler being, as before mentioned, fourteen inches long, and eight inches wide and deep, so it projects in front two and half inches, namely, as much as it is distant from the back wall of the flue, and the flues on each side of it are three inches wide.

The wall in front projects on each side so as to be flush with the end of the boiler, leaving a recess, however, above the man-hole to permit access to the steam and water-pipes, &c. A flat iron register-plate, *o*, suspended by a chain, passing over two pulleys, and having a counter-weight, *p*, appended to the other end of the chain, slides up and down in contact with the front of the boiler and end walls, to regulate the passage of the heated air underneath, partly around and over the boiler. *q* is the pipe which conducts the water from the reservoir above, to the feeder of the boiler, it is furnished with a stop-cock, *r*; *s* the pipe which conveys the steam above; it is connected at *t* with the main steam-pipe *u*, and has an inverted syphon, *v*, below it, to receive any water, acid, liquid, &c. which might descend from above, in case of a partial vacuum being formed in the boiler, and allow it to flow off at its end; *w* is a stop-cock in the main steam-pipe, and *x* a jointed curved pipe, made to assume any required position, like the nozzle of a fire-extinguishing engine, by means of the turning steam-tight joints *y y*; it is this pipe which, when the stop-cock *z* is opened, conveys the steam through any of the hollow bodies which, as before mentioned, require to be heated for lacquering them. 1 is the guage-pipe, for ascertaining whether the proper quantity of water is in the boiler; and 2 is a pipe and stop-cock for drawing off hot water from the boiler when required. 3 is the part connecting the water-supplying pipe with the boiler; this, with the altered Franklin's feeder, and other parts, are shown upon an enlarged scale in figs. 3 and 4; *q* the water-pipe, connected by the union joint 4, with the part 3. 5, in fig. 3, is a loaded conical valve, (shown by dotted lines,) the cone being widest above; to this valve a wire stem is affixed, which passes down through the pipe 6, and the end of it extends a little below the bottom of that pipe. 7 is a forked lever, which is suspended from the branch 8, affixed on the underside of the plate or cover of the man-hole 9; from the two sides of the fork, the two

rods 10 10, descend below the bottom of the pipe 6, and carry a flat plate 11, suspended between them, which encounters the valve-wire, and lifts the valve whenever a supply of water to the boiler becomes necessary, as happens when the hollow copper float, 12, suspended at the end of the forked lever, 7, is depressed by the sinking of the water in the boiler; when it immediately raises the shorter ends of it, with the rods and plate appended to them, and lifts the valve, 5, from its seat, permitting water to flow into the boiler until it has attained its proper height, and the valve shuts. 13 is a counter-weight affixed to an arm extending from one of the forks of the lever 7, and on the opposite end of the lever, whose office is to keep the float suspended at the surface of the water. All these internal parts will easily pass the man-hole into the boiler. Besides the plate 11, the rods 10 10 likewise carry a ring 14, which surrounds the pipe 6, and serves to guide them in their motions up and down. 15 is the connecting piece for the main steam-pipe *u*, to be adjusted to, by the union-joint 16; it has also the loaded pressure or safety-valve 17, in the top of it, the stem of the conical valve being guided by passing through a hole made in the centre of a cross-bar, below the valve-seat, as usual. 18 is the vacuum valve, the cone of it widening below; it is kept up to its seat by the counter-weight 19, affixed by an adjusting-screw 20, upon one end of the lever 21, which turns upon the standard 22, as a fulcrum, affixed upon the top of the boiler cover 9. The copper float 12, is formed of a short cylinder, having two inverted spherical ends, Mr. Callahan prefering that to the block of marble usually employed in the boilers of steam-engines.

We believe we have now entered sufficiently into the detail of this ingenious apparatus, to enable our readers, with the assistance of the figures, to construct it. And we may farther add, that it is rare indeed, when Mr. Callahan or his workmen have occasion to place the burning fuel under the boiler, and to cause the air to pass through

the fire to excite it from below; and indeed, only when he wishes to raise the boiler to its heat in a short time; as he has only to shut both the doors, and the horizontal draught of the air through the fire into the furnace, becomes so much increased, on account of the length of the flue, (about ten feet,) above the furnace, that *the simmering heat generally kept up in the boiler is very quickly changed to a boiling one*, and the steam raised in consequence; and when it has performed its office, he has only to open the upper door, and the fire immediately attains its usual reduced heat, and merely continues alight, ready to exert its useful powers whenever required.

XXXI.—*On the substitution of the Sylhet-Cane, or Ground Rattans, for Coir Ropes, in the Bridge of suspension erected at Allypore. By* COLLIN SHAKESPEAR, *Esq., Postmaster-General, Calcutta* *.

[From the *Calcutta Government Gazette*, of the 7th of March, 1825.]

THIS curious change was, we understand, effected with ease in a few hours. The result is very interesting, inasmuch as it proves the great facility and economy with which these ingenious structures can be composed and suspended.

It appears that canes from 100 to 225 feet in length, and from one to nearly two inches in diameter, are procured on our north-eastern frontier, merely for the cost of the labour in collecting them together. The Governor-General's agent, Mr. Scott, when at Sylhet, sent down to Calcutta, at the request of Mr. Collin Shakespear, a supply of canes coiled up like rope; and of which he has constructed the present small bridge of 130 feet span, by 5 feet in width. Not only the road-way, but all the radiating guys, catenary curved swings, preventer braces, and

* The Society for the Encouragement of Arts, &c. Adelphi, has lately voted its Gold Vulcan Medal to Mr. Shakespear, for his Rope Bridge of Tension and Suspension.

vertical suspenders are of cane, none exceeding one and a quarter inch in diameter, and many not three quarters of an inch.

The use of iron thimbles throughout the composition, gives an air of symmetry and neatness, while they greatly diminish friction, and add much to the strength of the bridge, which, like its rustic predecessor, has only one iron-jointed arm in the centre.

The appearance of the arch is singularly light, even more so than rope; and it is in reality lighter as a whole, because the bamboo cross-slips, forming the road-way, are lashed at once to the canes, and thus it becomes firmer than in the rope bridge, in which the tread-way is distinct and lies over the strands.

Eighteen canes, of 150 feet each, form the bearings. These are lashed together at each end of the bridge, and then bound round four *open hearts*, in substitution of dead eyes. Thus the *setting up power* acts in the same way as with the rope bridge.

There are no friction sheaves in the standards, with the exception of one for the lowest guy, the angle being acute.

The strength and durability of the cane is by some considered equal to that of rope, and this is a question that time will solve. Meanwhile it is quite clear, that if the cane should only last a season or two of the rains, and it is strongest when kept moist, the advantages gained to the country abounding in that useful and cheap commodity will be incalculable; no bridge whatever, we believe, having been attempted in that quarter up to the present time. And we may conclude that the natives, from habit and method of working up cane, will improve both on the neatness and strength of cane bridges now to be introduced, especially as they well know from experience, how to choose the best kind of cane, and to cut it at the proper season for the purpose intended.

The Right Hon. the Governor-General visited the cane bridge on Friday morning, and his excellency was pleased,

after a minute inspection, to signify his approbation of so novel and useful a structure.

The original experimental Berai Torrent bridge, still lying at Allypore under cover, was also exhibited to his excellency, preparatory to its return to its station, for the third season of approaching rains. It is then, we are told, the postmaster-general's intention, that it shall be accompanied by a new bridge for a torrent, a few miles west of Bancoorah.

This facility of transporting and erecting rope-bridges of all dimensions, naturally leads to the question, whether such machinery would not have proved very useful in the present warfare on our east and north-east frontiers, especially with Governor Shuldham's division in Cachar, a country intersected with innumerable nullahs, and no enemy in front.

XXXII.—*On the employment of the River Conferva as a Manure. By Mr.* JOHN WAGSTAFF, *of Norwich**.

GENTLEMEN, *Norwich, Dec.* 31, 1798.

AMIDST the various encouragements for the improvement of your country, you have been attentive to the comparative value of manures; but I have not in present recollection any immediate encouragement for the discovery of any new substance, whose unknown virtue might be called forth by experiment.

I beg leave therefore to lay before you a course of experienced benefit which has resulted from repeated trials made on the *River Conferva*, extracted with its roots, and so much of its muddy bed as adheres to their deep and interwoven fibres. These, drawn from a mill-stream about midsummer 1787, were laid to ferment, which followed in a few weeks; and when the heaps were broken, emitted effluvia which sufficiently indicated their fermentation.

The first experiment was on part of a field preparing

* From Vol. VII. of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

for turnips, in an equal proportion as to quantity, with a blended manure from stye and stable, and spread at the same time. The boundary of the Conferva manure was exactly determined, and the size of the roots and healthy expansion of the leaves of the turnips in no degree inferior to the general appearance and produce of the field. A load of this, more mixed and digested, and somewhat incorporated with a broken sod of the river's side where it was laden, I laid on an entire gravel, and thereon planted cabbage of different species, and at the same time planted some of either sort on a garden soil, and on a mud, in separation from all aquatic weeds and every other substance.

The progress on the first was great, and obviously superior to those on the garden mould; while those on the unblended mud were unhealthy and diminutive. In succession to the cabbage experiment, on part of the same space, in the ensuing spring, I planted, about eighteen inches asunder, ten potatoes, about the size of turkey eggs; and at an equal distance, parings of about fourteen more (from somewhat larger roots), in nine divisions or sets: the produce of which were, when taken up October the seventh, 1788, twenty-nine pounds four ounces from the ten whole potatoes, and twenty-nine pounds twelve ounces from the nine divisions of parings; and, what may appear singular, two of the largest potatoes, which weighed together thirty-one ounces, arose from the parings; the two largest from the whole potatoes, were twenty-five ounces.

As, perhaps, the mode of raising potatoes from parings may not be generally apprehended, I shall just take the liberty of remarking on that head, that what these were propagated from were not close pared, but in the manner which turnips generally are for the table, whereby two thirds or more of the farinaceous substance of the potatoes were boiled, and answered the intention of this esculent root.

In succession to the turnips before mentioned, followed barley, a large and better crop than ever grew on that field before; and the divisions where the aquatic compost was spread, were distinguishably productive. A contra-

distinction was still more obvious in a low field dibbled with wheat; a hilly gravel arising in one part of it was spread with this manure, and the nether and deeper soil around it left to its inherent quality; the former, though with only a thin surface of earth upon it, carried the appearance of double the crop to the better natural soil not spread with the aquatic compost.

I wish to add, that all river-weeds, mown in their most herbaceous state, and carried to the up-land arable, will remarkably promote the forward vegetation of turnips, and their consequent increase in root: but that operation leaves the more efficacious fibres and roots of the river-weeds unremoved. Nor, indeed, is the Conferva by its adhesion to the beds of rivers easily severed by the scythe, but by the method referred to, of drawing out the Conferva particularly, and in general the whole tribe of aquatic plants, root and herbage, with so much of the river soil as adheres to their fibres: and being exposed a time to the fervor of the longest days, their warmth, with the resident principles of fermentation in their blended mass, will prepare it for the useful purposes of agriculture; and when spread, as the common manure is spread, over arable land, an increase of its production will follow, perhaps signally superior to what ariseth from those dressings the soil has been accustomed to.

I may take the liberty of adding, that the Confervas, or somewhat of a similar manure, are easily procurable through the general part of the nation; for where rivers are not in the vicinity, there are but few districts where the current of the fountain, or the increasing rivulet do not wind their way. The borders of these shallow runs are not unfrequently encumbered with lofty palustrian plants, whose removal is an immediate advantage to the adjoining pasturage, and a consequent superior benefit to every arable field where applied. I am, with an esteem of your distinct patriotism, your respectful friend,

JOHN WAGSTAFF.

To the Society for the Encouragement of Arts, &c.

THE

TECHNICAL REPOSITORY.

XXXIII.—*Specification of the Patent, granted to* WILLIAM NICHOLSON, *of Soho-square, in the county of Middlesex, Gentleman; for various improvements in the Application of Steam to useful Purposes, and in the Apparatus required to the same.* Dated Nov. 22, 1806.—Term expired*.

WITH FIGURES.

I, THE said William Nicholson do hereby declare that my said invention, and the manner in which the same is to be carried into effect and practice, are described as follows. I convert water into steam by the application of heat in any of the usual and well-known methods, and permit the steam to rush out through one or more apertures, of such magnitudes respectively as may be best adapted to the several intended purposes. And I do permit the current or currents of steam to pass through a portion of the atmosphere, or of air communicating with the atmosphere, or of such other gas, or elastic fluid, or vapour, or smoke, as it may be desirable should pass along with the said steam.—And farther, I do dispose a tube or pipe (of a circular bore in preference) in such a position, with regard to the said current or currents of steam and air, or of steam and gas, elastic fluid, or vapour, or smoke, as that the said current or currents shall pass through the said tube or pipe, and be carried to its place of destination. And I do give unto

*The great success attending Mr. Richard Evans' late application of steam, in conjunction with air, to the exciting of the gas-coke fire in his furnace, as described in our last number, page 94; render it highly desirable to bring the above Patent, taken out by the late scientific Mr. William Nicholson, for the same and other purposes, before the notice of our readers; and as he quotes the late Dr. Wm. Lewis's improvements on the blowing machines, urged by the fall of water, so we likewise add them, in the succeeding article.—EDITOR.

the said tube or pipe a greater diameter, or size of perforation, than I allow for the first escape of the steam from the place where the same was produced; and I do make the said tube or channel either cylindrical or of such other figure internally as may be best suited to produce that effect which is well known to men of science by the name of the lateral action of fluids, and is described in many books, particularly in some writings of Professor Venturi, which have been inserted in a periodical work called the Philosophical Journal, which has been for a number of years published in London, and acknowledged by me as the editor thereof; and the effect of which said lateral action of fluids is particularly to be observed in the ancient and well known machine for producing a blast by the fall of a shower of water through an upright pipe; and in my said invention the lateral action of the current of steam doth take place with regard to the surrounding air, or gas, or elastic fluid, or vapour, which is carried along with it, so that the steam is made to produce an effect of the same nature as, but more powerful and advantageous than, is produced by the water in the said ancient machine; and I do apply the said current of steam and air, or of steam and gas, elastic fluid or vapour, or smoke, to such purposes of manufacturing or philosophical chemistry as may be useful according to the nature of the several cases respectively, namely,—(1) for agitating, or for impregnating, or for driving over in distillation, water or other fluids; or (2) for oxidating, corroding, rusting, or altering the nature and state of lead or other metals, or metallic ores, or mineral bodies, more or less heated or ignited by the action of fire in tubes, or muffles, or tests, or bodies, or vessels, or upon hearths, grates, or otherwise so placed, situated, or exposed, as may be best adapted for the changes intended to be produced in the said metals, metallic ores, or mineral bodies, by means of the said current herein before mentioned and described; or (3) I do cause the said current of steam and atmospheric air to pass through the tube or pipe herein

before described, or in some cases simply through an aperture or hole, into a receptacle or air vessel, wherein the steam is subjected to condensation, and from which vessel the atmospheric air, thus deprived of its steam, is conveyed to a furnace or any other place containing fire or burning materials, in order that the said current or blast of air shall and may excite and increase the strength, rapidity, and effect of the combustion.—And in order that my said invention may be more fully understood, I have hereunto annexed certain drawings or sketches of some of the forms of the apparatus, by means of which the same may be carried into effect.

In fig. 1, (plate VI.) *a* represents a pipe, through which the steam passes out from a boiler, or any other apparatus, whence it proceeds through a tube or pipe *d d*, carrying along with it a large portion of common air, which enters through the side spaces *b b*; and this mixed fluid mass passes thence through *c c*. If the surrounding part of the pipe or channel *d d* be made hollow, so as to form a space *d d*, enveloping the bore *c c*, and the hollow part *d d* be made to communicate with the boiler or general supply of steam, (without allowing any portion to escape by such communication,) the said surrounding part *d d* will be kept very nearly as hot as the steam itself, and the internal current will not be cooled by the sides of the said tube or pipe. Or otherwise, the said tube or pipe *d d*, if made of fit materials, may be kept at any required temperature by surrounding the same with fire; or, on the contrary, if need be, with some cold fluid or other refrigerating substance. In this, and in all other apparatus, the aperture of *a* must be of such a size as shall be best adapted to the intended emission of steam, of such elasticity and temperature as may be best suited to the object in view, and so likewise must be the diameters, form, and relative situation or distance of the tube or pipe *d d*; and since the said circumstances are themselves in their own nature variable, it is not possible for me to give any farther instruc-

tion respecting such dimensions and situations, than by declaring that a few trials will easily show what will be most advantageous to be adopted in each particular case.

Fig. 2 represents an improvement of the ancient water-blowing machine; in which, in its usual construction, a shower of water carries air down an upright pipe into a regulating belly, as is described in the writings of Lewis, Chaptal, and many other well-known authors of reputation. I have introduced the water from a head, or under any other pressure through *d*, into the close chamber or box *e e*, which surrounds the tube or channel *b b*, *c c*, and supplies the water through side apertures towards *c c*.—Air may also, if required, be allowed to pass through other side apertures as usual. In my improvement, a current of air and steam is strongly urged through the tube or pipe *b b*, by means of the current of steam from *a*, in the same manner as was explained and described in fig. 1. In this, as well as in other applications, the steam may be allowed to pass into the tube or channel through more apertures than one. As the lower part of the said improved blowing machine, fig. 2, consists as usual, of an air vessel of that description, which is called a regulating belly, the same need not be described, because it is well known by that name, and constitutes no part of my said improvements.

Fig. 3 exhibits a sketch of the manner in which my apparatus may be constructed and disposed for producing a very strong blast by steam. *m* represents the boiler, from which steam is supplied through the pipe *a a*, whence it passes into an air vessel *n n*, through an aperture at *b*, or through a tube or pipe *b c*, which favours the lateral action, and suffers the air and steam to pass into the water *e e*, whence the air rises into the upper space *f f*, and passes out through *g g*, to the furnace *k*. Cold water is introduced in the manner shown in fig. 2, or otherwise, through a pipe *d d*, from a head sufficiently elevated, or by means of a forcer, or otherwise, by means of a separate receptacle, as is hereinafter described and explained. *h* is a pipe

or tube through which the heated water is suffered to escape, but is subjected to a resistence or reaction, arising from the same being wiredrawn through a cock, or impeded by a loaded valve, which it must lift during its escape, or by the said water being conducted up to a proper elevation through a continuance of pipe, as represented at *i*. It will easily be understood by workmen or operators, who are conversant with hydraulic or other similar works, that the pressure or reaction within the air vessel may be adjusted to any desired quantity or force by means of these two communications, or by other well-known methods. At *c* the upright tube or pipe is represented as terminating in one or more valves. These are not essentially necessary, but they are useful to prevent the water from returning suddenly through *b* if at any time it should be found necessary to stop or suspend the supply of steam.

When the supply of water at *d* cannot with convenience be made by pressure from an upper reservoir, and the labour of forcing the water in by a pump, or by other powers not dependant on the engine, is wished to be avoided, I sink or depress the air vessel *n n* to a sufficient depth below the level of that supply of water which shall or may be obtainable on the spot, and by that means I gain a sufficient length in the pipe *d* to produce the requisite pressure, which will scarcely ever require to be greater than ten feet; and I bring the discharging pipe *h i* up again near the surface so as to allow the water a difference of level sufficient to produce the requisite current, and in this case I convey the steam-blast to its place by lengthening the pipe *a a*, or (which is better) by lengthening the tube or channel *c b*, above the top of the air vesel *n n*.

Or otherwise, in like cases, when the supply of water at *d* cannot with convenience be made by pressure from an upper reservoir, and the labour by forcing the water in by a pump, or by other powers not dependent on the engine, is wished to be avoided; and the last mentioned contrivance of depressing the air vessel, is inconvenient or

impracticable; then I introduce the water in separate or distinct quantities or portions, from a separate receptacle or close vessel, placed a little above the level of the water *e e*, fig. 3.

This receptacle must be provided with two cocks or valves, or a cock with several passages or ways through the same, in such a manner as that a communication shall be made for filling the said receptacle from without, at the same time that no communication shall be allowed between the air vessel *n n* and the receptacle or vessel now to be described; and also, as that in other positions of the said cocks or valves, or cock, a communication shall be made for emptying the water from the said receptacle or vessel into the air vessel at the same time that no communication shall be allowed from without.

As the alternate filling and emptying of a vessel in the manner here described, is performed, with regard to steam in a variety of steam engines, and must be quite familiar to engine-makers, it will only be needful to remark (1) that the opening or shutting of the said cocks or valves, or cock, may be most conveniently performed by a float within the air vessel, or within the separate receptacle, having a tail of communication which shall open or shut the said cocks or valves, or cock, at the times of the greatest rise or fall, by an action similar to that of the plug-bar, or equivalent gear of a steam-engine; and (2) that the said rod, if intended to operate out of the said vessels, may be passed through a stuffing-box; and (3) that provision must be made, by ways through the cocks, or by other well-known methods, to allow air to introduce itself from the air vessel into the receptacle while the water is discharging from this last; and also to allow the said air to escape, while the receptacle shall receive a fresh supply from without.

And lastly, I do declare, that the forms dimensions, relative magnitudes, situation and other particulars relating to the apparatus, required to carry my said improvements into effect, are capable of great variations, and will require

to be greatly modified, according to the conditions, objects, and purposes intended to be answered and obtained, and the local and other circumstances under which the work is to be performed; but that the said forms, dimensions, magnitudes, situation, and other particulars, may, from the description and explanations herein given, be determined with facility by any person of competent skill, and fit to be entrusted with the direction and construction of any apparatus of this or like description.

XXXIV.—*On the Blowing of Air into Furnaces, by a fall of Water. By the late celebrated* WILLIAM LEWIS, *M. D.**

WITH A FIGURE.

THE earliest method of animating the large fires of the furnaces for melting ores, appears to have been by exposing them to the wind. Such was the practice of the Indians of Peru before the arrival of the Spaniards in that country. Alonso Barba relates, that their furnaces, called guairas, were built on eminences, where the air was freest; that they were perforated on all sides with holes, through which the air was driven in, when the wind blew, which was the only time the work could be carried on; that under each hole was made a projection of the stone-work on the outside, and that on these projections were laid burning coals to heat the air, before its entrance into the funace. Some authors speak of thousands of these guairas burning at once, on the sides and tops of the hills of Potosi.

I have been informed, that several remains of a like rude process are to be seen in some parts of our own country. The old bloomery-hearths, as they are called, for running down of iron ore, are all on the tops of hills; a situation which can scarcely be supposed to have been chosen on any other account than for the conveniency of the wind, being in other respects extremely incommodious.

* From his *Commercium Philosophico Technicum*; or Philosophical Commerce of Arts, designed as an attempt to improve Arts, Trades, and Manufactures.

The gradual succession of bellows, to this precarious and insufficient way of supplying air, and the gradual improvements made in the structure and manner of working of the bellows, cannot, perhaps, be traced. It appears, that at some of our iron furnaces, and others, the bellows were formerly moved by a handle, as those of the smith's forge, or by the pressure of the foot upon a treadle, or by other means requiring the strength of men: and that, since the force of water has been called in aid, to move them, the quantity of ore run down has not only been far greater, but the separation of the metal more complete; insomuch, that great part of the iron now (1763) prepared at some considerable works, particularly in the county of Gloucester, is no other than what had been formerly left in the slags or cinders, for want of sufficient force of air.

The bellows used at our furnaces are composed of two boards joined by leather, nearly in the same manner as the common bellows. A cheaper kind of bellows, made entirely of wood, was introduced at the furnaces of the Hartz forest in Germany, according to Schluter, about the year 1620, and has since been received in Sweden, and some parts of France. It consists of two long boxes, of the same figure with the smith's bellows, one of which drops over the other, and is of such a depth, that when raised upon a hinge, as high as it is intended to be, it no where comes entirely off: the air enters by a valve, as in other bellows, and is forced out by pressing down the upper box: along the edges of the lower, or inner box, are placed laths, which slide horizontally in grooves, and to which are fitted springs, capable of pressing them an inch or two beyond the box, so as to form a ledge, of variable width, which always accommodates itself to the outer box, and in great measure prevents the air from escaping between them.

Though the wooden bellows have an advantage above the leather ones, of being less expensive and more durable, they have considerable defects; for it is scarcely possible to make the junctures so tight, as to allow no exit to the

compressed air, and the friction must necessarily be very great. Some have therefore had recourse to water, for doing the office of the under board of the bellows. A bellows on this principle, is described in the Philosophical Transactions, and I have been favoured with descriptions and drawings of two singular ones, now used at some of the iron works in this kingdom, one for the finery, and the other for a large iron furnace, in which the fuel is coke, and which requires the greatest force of air of any known kind of furnace.

There is another method of applying water, so as to produce a strong blast, by means more simple than any of the foregoing, and at little expense. A stream of water, falling through a pipe, in certain circumstances, carries air down with it: and this air afterwards disengaged from the water at the bottom, may be so collected, as to have no other vent, than a pipe which shall carry it to the furnace.

Machines constructed on this foundation, though little known among us, are used in different countries, instead of bellows, for animating the large furnaces. But their structure, and principles of action, have hitherto so little undergone a scientific examination, that those which have been found to answer the best, may be presumed to owe their excellence merely to chance, and that the workmen have often laid the greatest stress upon the proportions of parts which are inessential. These machines are, doubtless, capable of being much improved, so as to produce greater effects with a less quantity, and, what is of more consequence, with a less fall of water; and principles may, doubtless, be discovered, by which their structure may be regulated, and their power ascertained.

The importance of procuring commodious and cheap means of supplying the vast quantities of air, which the smelting furnaces require, induced me to examine the several accounts that have been published *of these simple substitutes for bellows:* and to make sundry experiments for bringing them nearer to perfection, and for establishing their laws of action.

An account of the principal Machines for blowing Air into Furnaces by a Fall of Water.

I. *A simple pipe.*—The first account I have met with of a machine for propelling air into furnaces by a fall of water, carrying down air with it, is of one at the copper or brass furnaces at Tivoli, near Rome, of which a description and figure are given, in the third number of the Philosophical Transactions, and in the *Journal des Scavans*, for the year 1666.

A square wooden pipe, of considerable width, and open at both ends, is placed upright. A stream of water runs in at the top, and is discharged at the bottom; and about the middle of the height of the pipe, a smaller horizontal one is inserted, which reaches to the furnace, and is said to convey to it a strong blast of air.

From so imperfect a description, we can learn little of the nature of the machine, or of the manner in which the blast is produced. It may be presumed, that the water, running forcibly against the side of the pipe, as it appears to do in the figure, is, in great part, dashed into drops; the intervals between which being filled by air, this air is successively pushed down, by the drops which follow, and afterwards escapes, as soon as it meets with a vent. There seems, however, to be some inaccuracy in the description, or some essential part omitted; for in such trials as I have made, when air thus conveyed into a perpendicular pipe along with running water, was discharged by a lateral aperture, part of the water always accompanied it in a stream; and more of the water seemed to issue out, in proportion as the quantity of air introduced was the greater.

II. *A pipe, with air-holes, inserted into an air-vessel.*—M. Belidor, in his *Architecture Hydraulique*, gives a more particular description of a water machine, used in some parts of France: he says there are four or five forges on the river Isere, between Romans and Grenoble, which have no other bellows.

The stream is divided into two channels, and each division falls into an upright pipe, ten or twelve feet high. Near the tops of the pipes are several holes, made sloping downwards from the outside to the inside: through these holes air enters, and is carried down by the water; though the experiments in the following section will show that the quantity of air thus introduced, is not so great, as in the dispositions mentioned hereafter.

The essential difference of this instrument from the foregoing, consists in its having an air vessel, or reservoir for the air, at the bottom. An oval vessel near seven feet high, and three or four feet wide, is inverted, and its lower edge let into the ground, five or six inches. The lower ends of the two upright pipes enter into the top of the tub, and under each pipe is a kind of small stool, which the water falls on. The water, loaded with air, dashing against the stools with great velocity, rebounds, and its air is disengaged: a pipe communicating with the top of the tub, carries the air to the furnace, while the water runs out at a hole in the lower part; a sufficient height of water being kept in the tub, above this hole, to prevent any air from escaping by it.

III. *A funnel and pipe, without air-holes, inserted into an air-vessel.*—M. Marriotte, in his treatise *Du Mouvement des Eaux*, gives an account of another contrivance for blowing fire by a fall of water, which, Belidor says, from the information of a friend, who travelled in Italy, is used in the Tiburtine mountain, near Rome, and near Salan, on the Lac de Guarde.

A wooden or tin pipe, fourteen or fifteen feet high, and one foot in diameter, has its lower end fixed into an air-vessel, or inverted tub, as in the preceding section, from the one side of which a blast-pipe goes tapering to the furnace.

The upper end of the large upright pipe is contracted to an aperture of three or four inches, into which is fitted a funnel, whose neck exactly fills it. Into the funnel there

falls a stream of water, from the height of ten, fifteen, or twenty feet; which we may presume to be dashed into drops in its fall, and to push down air before it, on the same principle as in the machine of Tivoli, already mentioned.

This instrument promises to be more effectual than either of the preceding; though in this country it can be of little use, so high a fall of water being rarely to be procured, at least in those places where smelting furnaces are established.

IV. *A funnel and pipe, with air-holes, inserted into an air-vessel.—At Lead-hills, in Scotland.*—In No. 576 of the Philosophical Transactions, in the year 1745, Mr. Stirling describes a machine, erected in Scotland, for blowing air into the furnaces in which lead ores are smelted; and for conveying fresh air into the works, so as to save the trouble and expense of the double drifts and shafts, and the cutting of communications between them.

A stream of water runs into a wooden funnel, so as to keep it always nearly full: the height of the funnel is five feet, and the diameter of its throat three inches and a half. The neck of the funnel is inserted into an upright pipe, whose diameter is five inches and a half, and its length fourteen, fifteen, or sixteen feet: immediately under the throat of the funnel four air-holes are made in the pipe, at equal distances round it, about an inch and a half wide, sloping downwards from the outside to the inside.

The lower end of the pipe enters into a wooden tub, close at top, but without a bottom, six feet high, and five and a half feet wide, sunk into a pit dug in the ground, and well rammed about with clay: in the middle of the tub, directly under the pipe, is a flat stone about two feet high, for the water to fall upon; and into the top of the tub is fixed a pipe for carrying off the air, communicating at the farther end with an iron one, which enters the furnace: for regulating the blast a small hole is made in some convenient part of the pipe, which is stopped with a pin, or

opened, according as the blast is required to be more or less strong. The hole in the lower part of the tub, by which the waste water passes out, is about five inches square; and one side of the pit, where the water runs off, is a little lower than the surface of the stone, so that the water can never rise high enough in the tub to cover the stone; though it is supposed to continue always a considerable height above the top of the hole.

Though this machine is said, in the Transactions, to be sufficient for the smelting of harder ore than any in Leadhills, where it was erected, I have been informed, by a person concerned in those works, that it has since been found not to answer so well as could be wished; and that accordingly it has been laid aside, and its place supplied by the common bellows.

In Dauphiny, in France.—The blowing machines used in Dauphiny, for the forges and smelting furnaces, have a great resemblance, in their general structure, to the foregoing. They are described by Swedenburg, in the second volume of his *Regnum Subterraneum*, but with little exactness: a more accurate description, and figures of them, taken from the papers left by Reaumur, are inserted in the *Art des Forges et Fourneaux à Fer*, just published by the direction of the French academy.

The upright pipe, (see plate VI. fig. 4) is generally between twenty-five and twenty-six feet high: it is composed of two pieces of fir, hollowed and joined together by iron-work. Instead of a distinct reservoir or funnel on the top, a part of the pipe itself is hollowed, so as to perform the same office: at the top it is twelve inches and a fifth in diameter, (English measure,) from thence it grows narrower, to the depth of nearly thirty-four inches, where its width is only about three inches and three quarters; immediately below this part, called the choak, its cavity widens to nearly eight inches and a half, and this width it preserves throughout the rest of its length. Under the choak are ten air-holes, six of which are in one horizontal plane,

at equal distances from one another, and the rest are about three inches and three quarters lower down: all the holes are cylindrical, near two inches in diameter, and cut at such an obliquity, that the orifice of the upper ones is, on the inside of the pipe, eight inches; and on the outside only five inches below the choak.

The tub, or air-vessel, which receives the lower end of the pipe, is five feet and a half, or a little more, in depth, and nearly as much in width: the pipe enters into it about seventeen inches: about the middle of its height, is a flat stone or iron-plate, supported by cross bars of wood. The air passes off, as already mentioned, through a pipe inserted into the upper part of the tub, and the water through a hole at the bottom: on the outside of this hole is fixed a wooden frame, with an upright slider, by which the aperture for letting out the water may be occasionally increased or diminished. The blast is regulated, and the air suffered to escape, when it is not wanted, by a hole in the blowing pipe, to which is fitted a valve or stopper.

One of these machines is said to be sufficient for the forge, or iron finery: and two or three for the furnace in which the iron ore is run down.

[*To be continued.*]

XXXV.— *On Prison Labour; and on introducing the Culture of Hemp into Ireland. By Mr.* WILLIAM SALISBURY.

DEAR SIR, *Brompton, August* 3, 1825.

My letter to you on the subject of prison labour, inserted in the 36th number of the *Technical Repository*, having excited considerable attention in Ireland, permit me to offer you some further information, in illustration of the advantages that may be derived both in Ireland and this country, when proper methods are had recourse to for the improvement of the discipline in criminal gaols.

My former letter was upon the subject of *flax:* I now offer you some reasons to prove that the cultivation of *hemp*

in Ireland, will be found to answer the growers purpose; and in order to show that prisoners may be usefully employed in dressing it, I shall transcribe from the books of Bridewell Hospital, the account of an experiment, recorded therein, which was made by my people five years since. I remain, dear sir, yours very truly,

To T. GILL, *Esq.* WILLIAM SALISBURY.

GENTLEMEN, *Brompton, Nov.* 4, 1820.

In consequence of the regret expressed by several members of your prison committee*, that no efficient system of labour had of late years been established for the vagrants, &c. I took the liberty to state, that I had succeeded in introducing employments in similar places, the advantages of which principally arose from using articles of British growth, in lieu of the more costly materials imported from other countries: and that I could in like manner set to work the prisoners who are confined in Bridewell, and which I received permission to do on the 13th ult.

As the whole of the materials are nearly worked up, it affords me the opportunity of stating the results of the prisoners' labour for your information, agreeably to a request sent me by the same committee on Wednesday last.

The order stated that I was to employ a journeyman, to fix the necessary utensils for the work, and an instructor, at one guinea per week: accordingly,

Dr.	£	*s.*	*d.*
John Anderson has been employed five weeks, at 18*s.*	4	10	0
C. Salisbury, two weeks	2	0	0
Paid for paste	0	2	0
Paid to J. Campbell, a pauper, for work performed after the expiration of his committal	2	19	0
Ditto to other prisoners . . .	0	1	5½

* See the report of the Governors of Bridewell Hospital, in answer to Lord Sidmouth's circular, "On the state of the gaols in England, &c. &c."

Total expense for labour, &c. . .	9	12	5½		
76 lb. yarn, received from the matron, at the present price of flax, as spun by the females in the prison . . .	1	18	2		
6 lb. of hemp yarn, spun by female prisoners	0	1	6		
470 lbs. of hemp *, as purchased from the growers, at 3*d.* per lb., and manufactured by the prisoners . . .	5	17	6		
				17	19 7½
Cr.					
By 140 yards of linen, at 1*s.* per yard .	7	0	0		
By 15¾ ditto, for towels, at 5*d.* . .	0	6	6		
† By hemp prepared to make 900 yards of towelling, which may be spun and made in the prison, at 5*d.* per yard .	18	15	0		
				26	1 6

Thus have I rendered you the above account, agreeably with the order of your court.

N. B. The whole of the above cloth has been made to match the sheets and towels used at Bethlem hospital; and is deposited with the prison-keeper, T. Harpur, for your inspection.

It is matter of great gratification to me, in furnishing an account so favourable, after the experience of only six weeks, that I am enabled to prove the practicability of the system, by presenting to your immediate inspection the whole proceeds of the prisoners' labour; showing, at the same time, the futility of the argument, "that *the shortness of the time, for which prisoners are sent to bridewell, will not permit of their being usefully set to work.*"

One supposed objection to the employment of prisoners arises from the consideration, that the use of machinery

* Any quantity of hemp may be purchased, at the above rate, of the growers at Tooting or elsewhere: that abovementioned, had been an old stock in the prison.

† A deduction should be made for the time it will require to weave the above, which will depend on the number and ability of the prisoners. I believe Bridewell to be seldom without weavers of one kind or other. It should be remarked, that several paupers were employed who had no allowance for their work; the above profit will be ample to provide for that.

has so far outstepped the effects of manual labour, that it is thereby almost rendered unavailable at the present time. My professed object has been to obviate this, by the introduction of similar instruments, comparative in effective power, when adapted to the physical strength of persons in general; and thus, while the sturdy and robust, by turning a windlass, or moving a lever, may assist in the manufacture, the nicer operations are performed by the more intelligent and deserving of those wretched outcasts. While we can thus make use of British machines, we can encourage and extend the culture of our natural soil, *and create employment in work* heretofore performed by *automatons*. Hence the additional advantage of *not infringing* on the exercise of *any calling*, on which other persons are dependent for their daily subsistence.

The following facts will, in some degree, show the moral effect a system of this kind will have on the prisoners themselves.

The hard labour, attending the minor parts of the process, will always induce persons to offer their services to work at any easier task of which they may be capable. This was the case with the vagrant, John Campbell, abovementioned, who, being set thus to work on his entrance into the prison, proffered his services as a flax-dresser; and who, after the expiration of his commitment, when about to be passed to Ireland, offered to remain, on very moderate wages, in the same employ; and, by the savings from his small earnings, he has been enabled to put himself into decent plight, and found means of being recommended, by his industrious conduct, to Deptford dockyard, where his services cannot fail to become greatly useful. Thus has a valuable workman been rescued from the lowest state of pauperism and misery, and placed in a situation which may enable him to become hereafter a creditable member of society; at the same time, that your establishment has reaped the benefit of the means which caused his restoration. This example induced two weavers

and a stocking-frame worker to make the same offers, and who would have laboured with the same advantage if my permission had extended to the means of employing them.

It is a fact not generally known, that a number of these wretches are no sooner freed from one place of durance, than they presently become the inmates of another. This was the case of another prisoner, a professed thief, J. Scott, who was lately discharged from the county gaol of Kent. This man offered his services as a spinner of yarn, an art he had acquired in that prison, as I had been instrumental in getting him taught, and thus employed, by having established similar work in that prison, I considered this circumstance as prophetic of success, that will ultimately attend a regular system of prison labour, whenever means shall be taken for the purpose generally.

From these circumstances, I trust I may venture to add for your information, that little more appears wanting, than the superintendance of a person qualified to appreciate and apply the abilities of each prisoner on his committal; and to establish a course of discipline in Bridewell Hospital, that will hereafter be deemed worthy of general imitation. I am, gentlemen, your very obedient and most humble servant,

WILLIAM SALISBURY.

To the Governors of Bridewell Hospital.

Society for improving the condition of the Irish Peasantry. Established in 1822.

At a meeting of the committee of this society, held in Sackville-street, Dublin, May 18, 1824,

Richard Wellesley, Esq. M. P. in the chair.

Resolved, that the premium of twenty pounds, for the best essay on the mode of cultivating hemp, in Ireland, be awarded to Mr. William Salisbury, and his manuscript be returned to him, that he may publish it for his own benefit.

Signed (by order) J. C. MITCHELL, Secretary.

For Mr. WILLIAM SALISBURY, *Botanic Garden, Brompton.*

Mr. Salisbury having resided in the province of Munster last season, as agent for the above society, he was by them, desired to turn his particular attention to "*the best means of cultivating hemp, as applicable to the husbandry of that country;*" and thereby he is enabled to state, that *there are many thousands of acres of land capable of producing that article of the best quality, and that any quantity can be produced;* as all the necessary means are within the power of many farmers, whenever they shall have afforded them the proper instructions and due encouragement.

With a view to unite to the above observations a practical effect, relative to the after preparation, a crop of hemp was last season grown at Brompton, and since Mr. Salisbury's return there, able persons have been consulted and employed thereon in various ways, that are used to prepare the material for market; from whence, a method has been discovered of *rendering it capable of being peeled by hand,* a practice which has long been employed in India and in other countries where the population is numerous, and labour cheap; hence its peculiar adaption to the present state of the working-classes in the south of Ireland. Experiments having proved that the after-treatment of hemp can be performed in all its stages by females, and even children of five years old are thus employed!

It is also a fact, that hemp thus prepared, is manufactured into twine and cordage, which is used in the fisheries on the western coast of England, and a preference is given by the manufacturers thereof, to *the peeled hemp,* over that which is crushed by powerful mills*.

* A manufacture has long existed at Bridport, in Dorsetshire, of *hemp, peeled gratis* by the poor people there, from the entire stems, *without water steeping*; the *entire bark*, containing the *fibrous part*, being slipped off from the woody stems, or *boom* as it is termed, and which is used by them for fuel, and is indeed the only reward of their labour.

This hemp has been long celebrated for *its great strength*. Bow-strings, of the length and produce of entire stems, shoemakers' thread, fishing-lines, and nets, horse-girths, bed-sacking, &c. are made of it, and are much sought after.—Editor.

The various honours repeatedly conferred upon Mr. Salisbury by the society, added to his unfeigned desire to give effect to his professional views of employing the Irish poor, induced him to lose no opportunity of fully detailing all such measures as tended to give effect to the objects which the Society had in view; and, consequently, he made the essay alluded to in the above resolution of the Society, as full and perfect as his ability would permit. He has, however, reflected how far short any description must be in directing or explaining any manual operations, when compared with the advantages to be derived from familiar lectures, accompanied with practical operations, that may be repeated until all that is necessary is completely known to those who are interested therein.

Note.—Mr. Salisbury having his above mentioned essay, together with his "Hints for the improvement of Ireland," now ready for publication, we have his permission to add hereto the following *preface to that work*, and which we have great pleasure in inserting here, for the use of our Irish readers in particular.

Preface.

From the earliest periods of the publication of works on British husbandry, every writer on that subject has regretted the want of improvement in the management of flax and hemp; on the grounds that *the means pursued were detrimental to the health of the neighbouring inhabitants, wasteful of the materials, and both tedious and expensive in their operation.* The author has, for many years past, made the study of rural economy his profession, and the above considerations have by him been constantly kept in view; while every opportunity was embraced, and every experiment examined, which were likely to elicit any improvement in those arts.

A description of a method of extracting vegetable fibres, given to him by his friend the late Dr. William Roxburgh, while that gentleman made extensive researches, by order

of the East India company, during the last war, to discover some substitute for hemp; and being himself employed, two years since, in discovering the best means of *scutching* the foliage of the *phormium tenax*, or New Zealand flax plant: and that, in a local part of England *, the preparation of hemp was carried on in a way whereby the fishing-lines and nets made thereof, were most generally approved of, induced him to grow, last season, a crop of hemp at Brompton; at the same time a gentleman at Kingston-upon-Thames was stimulated to make a similar experiment, and persons from the part of England above alluded to, were employed to harvest and prepare it; by which means hemp, the growth of Middlesex and Surrey, has been produced of a very superior quality. Whilst the earlier parts of these processes were going on, the author was deputed to proceed to the south of Ireland, to endeavour to discover what new employment might be introduced for the poor there: and it is from actual observations, made during eight months' residence there, and the results of the work going on at Kingston, that the following pages have been compiled.

With regard to the practical application of the measure to that country, he has only to remark, that the same physical powers belong to the Irish as to the rest of mankind, with inclinations towards industry if effective employment be offered them; and with a fervent gratitude for useful instructions, and for favours bestowed upon them, the Irish labourer will absolutely put those of this country to the blush; so that the introduction of any new system is, in comparison, easy, so far as regards the propriety of conduct in the poor themselves. It therefore only remains to consider what prospect there is of getting hemp to grow in that part of the empire.

On this head he has the authority of several of the most intelligent resident gentlemen for stating, that fine crops were some years since produced on the lands, now become

* Bridport; (see foregoing note). Bridport twine is known to all net-makers.

mostly out of crop, near Mallow, on the rich banks of the Blackwater river: and also at Clonmel, on the shores of the river Suir: he has also the authority of an Irish member of Parliament, that the cultivation was not proceeded in because no persons were at hand who understood the after management of the crop when grown*.

As the season has approached when the rural arts will proceed in pace with other improvements, it is hoped that in future, persons will be encouraged to give *practical instructions* in this and similar objects, for which that country offers such bountiful encouragement. *Flax* has long been a principal support to the north of Ireland, and why may not *hemp* be made as nationally useful in the southern part of that country? The experiments on which the following facts are founded, proves that even every child, from four years old, may be made useful, if its efforts are properly directed! And this in the production of an article for which we are so greatly beholden to the better policy of foreign nations, and for the cultivation of which, in the British empire, premiums are continually offered by the Society for the encouragement of Arts, Manufactures, and Commerce.

[*To be continued.*]

XXXVI.—*On Screw-stocks, Dies, Taps, and Screw-plates, &c. By the* EDITOR.

[*Continued from page* 70.]

WITH FIGURES.

Mr. Peter Keir's improved Screw-stocks, Dies, &c.

MR. KEIR, the long celebrated mechanic and engineer, of Camden Town, having noticed the Editor's articles in two of our late numbers on the above interesting subjects,

* It is not a little remarkable that, although there are to be found in that country music-masters, dancing-masters, drawing and fencing-masters, orators, pugilists, and professors in all the other liberal and polite arts, yet that not a single person could be found to teach the simple means required to harvert a field of hemp!

has kindly permitted him to publish a description of the screw-stocks, dies, &c. which he made for his own use, on his first commencing business, now, nearly *forty years* ago, and which he has had in use ever since, the screw-stocks being as perfect as ever.

In plate VI. fig. 5, is a top view of one of these screw-stocks and dies; the screw-stocks are an oblong frame, with two handles to it; the dies are shaped and fitted to the width and depth of the aperture in the stock, but they are supported by and slide upon the projecting parts of two hardened steel cylinders, which are lodged rather more than half their thickness in the sides of the stock, and project internally, as shown by the dotted lines in the figure, and still plainer in the large section, fig. 7. Besides the cylinders, two adjusting-screws are provided at each end of the stock, to press the dies forward in use, and keep them in the centre of the stock, to balance it the better.

Thus far, it is hoped, we have given a clear idea of the general construction of the stocks and dies. There are, however, certain practical rules to be attended to in their construction, without the knowledge of which, considerable difficulties might be experienced by persons attempting to make them; these particulars Mr. Keir has liberally explained to us.

Fig. 6 represents an enlarged view of the wrought-iron frame of the stock, with the oblong aperture *a a* in it, and ready for drilling a cylindrical hole in it, as shown by dotted lines, to receive one of the steel cylinders, shown in fig. 8; previous, however, to this operation, a scribe line must be made along the centre of the internal face of that side of the frame, by means of which, a groove or furrow may be cut along it, of a sufficient depth to guide the drill in its passage. A piece of bar-iron *b*, fitted to the length of the aperture in the frame, and its sides made truly flat, but without any furrows along them, is then to be firmly secured by the wedges *c c*, in contact with the side of the

frame, as shown. Pricks having previously been made at each end of the frame in the proper places, to guide the drill at its entrance, and to support the frame on the conical point of the screw of the sliding puppet of the lathe, the hole may be drilled; the groove cut along the internal face of the frame, causes the hole to be deeper in the side of the frame, than in the side of the iron block *b*. A hardened and tempered steel bit, with teeth cut lengthwise all round it, of the shape shown in fig. 9, and in section at fig. 10; it being made tapering at the point, and swelling out to the diameter of the intended hole, and is then again reduced behind, must then be passed through the drilled hole, to bring it to a truly cylindrical shape; and one end of it may be opened of a gentle taper, to receive the enlarged head of the steel cylinder, fig. 8. The other side of the frame, prepared as described, may then be drilled, the opposite, or entire side of the block *b*, being previously wedged fast in contact with it, and be finished in the above manner, to receive another steel cylinder, similar to the former. Four screwed holes to receive the four screws, being then made in the frame, it must be *case-hardened* to a proper depth, which finishes it for use; the outside being thus made *very hard*, whilst internally, it is still iron, and of course *stout* and *tough*. The inner sides of the frame should not be exactly parallel to each other, but be made a little wider above than below, in order to fit the dies in it the readier, which could not be the case were it parallel, as the dies might then be made too narrow in fitting them, and for which there is no remedy.

The dies are first fitted to the frame by filing them, whilst the steel cylinders are removed; scribe marks are then made, by which hollows are filed in each side of them, with a round file, so as nearly to fit the cylinders. The dies are then secured in their places in the frame, by means of the screws, and the hollows are finished by pass-

ing the steel toothed bit, figs. 9 and 10, through the holes, the hardened sides of the frame preventing the bit from exercising any cutting action upon them. The dies being thus fitted into the frame, are to be tapped and finished as usual, as shown in figs. 11 and 12, and be hardened and tempered. Should they happen to warp in the hardening, their flat sides may be readily ground into form, and the hollows in their sides be corrected by means of a cylindrical rod of soft iron, being turned to a proper size in the lathe, and one end of it being held firmly in a vice: a little oil and flour-emery must be applied to the iron rod, and the hollows in the dies be rubbed upon it, backwards and forwards, until, on trial in the frame, they are found to fit the two cylinders perfectly.

A half-round steel bit, of the form of the toothed bit above described, may also be employed instead of it, to fit the dies into the frame.

In our continuation of this article we shall describe the admirable manner in which Mr. Keir has fitted up his improved stocks and dies for cutting the grooves in flat, or square threaded screws, by the introduction of a cutter, and by means of which the work is performed better and quicker than by dies only, as usual.

[*To be continued.*]

XXXVII.—*On propagating the White-Thorn, from cuttings of its roots. By the late* SAMUEL TAYLOR, *Esq. of Moston, near Manchester**.

EVERY one, I think, will allow that fences are material objects to be attended to in agriculture; and also be convinced that there is no plant in this kingdom of which they can so properly be made as the *Cratægus Oxyacantha Linnæi*, or common white-thorn. In consequence of my

* From the Transactions of the Society for the encouragement of Arts, Manufactures, and Commerce. The Society voted its silver medal to Mr. Taylor for his communication.

being convinced of this, I have been induced to make a few experiments to effect the better propagation of that valuable plant; the result of which, along with specimens of my success, I beg leave to submit to the inspection of the Society.

In the year 1801, I had occasion to purchase a quantity of thorns, and finding them very dear, I was determined to try some experiments, in order if possible to raise them at less expense. I tried to propagate them from cuttings of the branches, but with little or no success. I likewise tried if pieces of the root would grow; and I cut from the thorns I had purchased, about a dozen of such roots as pleased me, and planted them in a border along with those I had bought. To my great astonishment not one of them died; and in two years they became as good thorns as the average of those I had purchased. The thorns I purchased were three years old when I got them. In April 1802, I had occasion to move a fence, from which I procured as many roots of thorns as made me upwards of two thousand cuttings, of which I did not lose five in the hundred.

In the spring of 1803, I likewise planted as many cuttings of thorn roots as I could get. In 1804, I did the same; and this year I shall plant many thousands.

I have sent for the inspection of the Society specimens* of the produce of 1802, 1803, and 1804, raised after my method, with the best I could get of those raised from haws in the common way, which generally lie one year in the ground before they vegetate. They are all exactly one, two, and three years old from the day they were planted.—I was so pleased with my success in raising so valuable an article to the farming interest of this kingdom at so trifling an expense, (for it is merely that of cutting the roots into lengths and planting them) that I was determined to make it known to the world.

The method of raising the thorns from roots of the plant is as follows.

* Preserved in the Society's repository.

I would advise every farmer to purchase a hundred or a thousand thorns, according to the size of his farm, and plant them in his orchard or garden, and when they have attained the thickness of my three-year-old specimens, which is the size I always prefer for planting in fences, let him take them up and prune the roots in the manner I have pruned the specimen sent, from which he will, upon an average, get ten or twelve cuttings from each plant, which is as good as thorns of the same thickness; so that it will be easily perceived that in three years he will have a succession of plants fit for use, which he may, if he pleases, increase ten-fold every time he takes them up.

The spring (say all April) is the best time to plant the cuttings, which must be done in rows half a yard asunder, and about four inches from each other in the row; they ought to be about four inches long, and planted with the top one-fourth of an inch out of the ground, and well fastened; otherwise they will not succeed so well.

The reason why I prefer spring to autumn for planting the roots, is, that were they to be planted in autumn, they would not have got sufficient hold of the ground before the frost set in, which would raise them all from the ground, and if not entirely destroy the plants, would oblige the farmer to plant them afresh.

I have attached the produce of my three-year-old specimen to the plants it came from, cut in the way I always practise; on the thick end of the root I make two, and on the other end one cut, by which means the proper end to be planted uppermost, which is the thick one, may easily be known.

Although I recommend the roots to be planted in April, yet the farmer may, where he pleases, take up the thorns he may want, and put the roots he has pruned off into sand or mould, where they will keep until he has leisure to cut them into proper lengths for planting; he will likewise keep them in the same way, until planted.

The great advantage of my plan is: first, that in case

any one has raised from haws, a thorn with remarkably large prickles, of vigorous growth, or possessing any other qualification requisite to make a good fence, he may propagate it far better and sooner from roots than any other way. Secondly, in three years he may raise from roots a better plant than can in six years be raised from haws, and with double the qnantity of roots; my three-year-old specimen would have been half as big again, had I not been obliged to move all my cuttings the second year after they were planted.

It would not be a bad way, in order to get roots, to plant a hedge in any convenient place, and on each side trench the ground two yards wide, and two grafts deep; from which, every two or three years, a large quantity of roots might be obrained, by trenching the ground over again, and cutting away what roots were found, which would all be young and of a proper thickness. I do not like them of a larger size than the specimens sent.

I am at present engaged in several experiments, to endeavour to propagate the thorn from the branches, which, if successful, I will communicate to you; but I am of opinion, that what is now done is sufficient.

MISCELLANEOUS.

XXXVIII.—*Queries on Wilson's Artificial Stone Chimney Pieces, and on heating Warm-baths. By a* CORRESPONDENT.

SIR, *Aberystwith, Aug.* 24, 1825.

I TAKE the liberty to enquire whether the manufactory of artificial stone chimney-pieces, mentioned at page 400 of the 2d vol. of your *Technical Repository*, is still carried on by Mr. Charles Wilson, the inventor; and at the same place from whence he dated that communication, viz. Worcester-street, Southwark.

I trust you will excuse my applying to you for inform-

ation which at present I have no other means of obtaining. I should be glad to make trial of his invention if it were likely to answer. I am, sir, &c.

To T. GILL, *Esq.* W. G. C.

P. S. Do me the favour to inform me if you are acquained with any convenient mode of heating a warm-bath in the chamber where it is used. A compact apparatus for this purpose would be a great acquisition to private families.

Replies to the above Queries, by the EDITOR.

In reply to the above queries, we have to inform our worthy correspondent, that Mr. Wilson has been dead some years; and we are not aware that any one carries on the manufacture of his artificial stone, although the chimney-pieces seemed to answer their purpose well.

We believe the best mode of heating warm-baths is by steam. We know of one so heated in a bed-chamber. Perhaps a steam-boiler, fitted up as Mr. Callahan's is, as described in this month's number of the *Technical Repository*, might answer well for this and many other purposes, and the hearth might prove serviceable for heating a stewing-plate, an ironing-stove, &c. &c.

LIST OF PATENTS FOR NEW INVENTIONS,

which have passed the Great Seal since July 26, 1825.

To Charles Friend, of Bell-lane, Spital-fields, in the county of Middlesex, Sugar Refiner; for an improvement or improvements in the process of refining sugar. Dated July 26, 1825.—To be be specified in six months.

To John Redhead, of Heworth, in the county of Durham, gentleman; for certain improvements in machinery, for propelling vessels of all descriptions, both in marine and inland navigation. Dated July 26, 1825.—In two months.

To John Edward Brooke, of the Township of Headingley, in the parish of Leeds, in the county of York, woollen manufacturer; and James Hardgrave, of Kirkstall, in the said Township, woollen manufacturer; for certain improvements in, or additions to machinery used in scribbling and carding wool, or other fibrous substances. Dated July 26, 1825.—In six months.

To David Oliver Richardson, kerseymere and cloth printer; and William Hirst, manufacturer; both of Leeds, in the county of York; for certain improvements in the process of printing or dyeing woollen and other fabrics. Dated July 26, 1825.—In six months.

To James Kay, of Preston, in the county of Lancaster, cotton spinner; for his new and improved machinery for preparing and spining flax, hemp, and other fibrous substances, by power. Dated July 26, 1825.—In six months.

To Richard Witty, of Sculcoates, in the county of York, civil engineer; for an improved chimney for argand and other burners. Dated July 30, 1825.—In six months.

To Joel Lean, of Fishpond-house, near Bristol, gentleman; being one of the people called quakers, for a machine for effecting an alternating motion between bodies revolving about a common centre or axis of motion; and also certain additional machinery or apparatus for applying the same to mechanical purposes. Dated July 30, 1825.—In six months.

To the Rev. William Barclay, of Auldeare, in the county of Nairn; for an improved instrument to determine angles of altitude or elevation, without the necessity of a view of the horizon being obtained. Dated July 30, 1825.—In two months.

To Richard Badnall the younger, of Leek, in the county of Stafford, silk manufacturer; for certain improvements in the manufacture of silk. Dated July 30, 1825.—In six months.

To Samuel Bagshaw, of Newcastle-under-Line, in the county of Stafford, gentleman; for a new method of manufacturing pipes for the conveyance of water, and other fluids. Dated August 8, 1825.—In two months.

To George Charleton, of Maidenhead-court, in the parish of St. John, Wapping; and William Walker, of New-grove, Mile-end-road, in the parish of St. Dunstan, Stepney, both in the

county of Middlesex, master mariners; for certain improvements in the building or constructing of ships, or other vessels. Dated August 10, 1825.—In six months.

To Samuel Lord, James Robinson, and John Forster, all of Leeds, in the county of York, copartners, merchants, and manufacturers; for certain improvements in machinery for, and in the process of raising the pile on woollen cloths and other fabrics; and also in pressing the same. Dated August 11, 1825.—In two months.

To William Hirst, Henry Hirst, and William Heycock, woollen cloth manufacturers; and Samuel Wilkinson, mechanic; all of Leeds, in the county of York; for a certain apparatus for preventing coaches, carriages, mails, and other vehicles from overturning. Dated August 11, 1825.—In six months.

To John Stephen Langton, of Langton-juxta-Partney, in the county of Lincoln, esq.; for an improved method of seasoning timber, and other wood. Dated August 11, 1825.--In six months.

To Jacob Perkins, of Fleet-street, in the city of London, engineer; in consequence of a communication made to him by a certain foreigner residing abroad; for certain improvements in the construction of bedsteads, sofas, and other similar articles. Dated August 11, 1825.—In six months.

To Henry Richardson Fanshaw, of Addle-street, in the city of London, silk embosser; for an improved apparatus for spinning, doubling, and twisting or throwing silk. Dated August 12, 1825—In six months.

To James Butler, of No. 64, Commercial-road, in the parish of Lambeth, in the county of Surrey; for a method of making coffins, for the effectual prevention of bodies being removed therefrom, or taken therefrom after interment. Dated August 12, 1825.—In two months.

To Marc Lariviere, now residing at No. 21, Frith-street, Soho, in the county of Middlesex, mechanician; late of Geneva, in Switzerland; for a machine for perforating metal plates, of gold, silver, tin, platina, brass, or copper; being applicable to all the purposes of sieves, hitherto employing either canvass, linen, or wire. Dated August 15, 1825.—In two months.

To Joseph Alexander Taylor, of Great St. Helens, in the city of London, gentleman; for a new polish apparatus, for household purposes. Dated August 13, 1825.—In six months.

To Charles Downing, of Bideford, in the county of Devon, gentlemen; for certain improvements in fowling-pieces, and other fire arms. Dated August 15, 1825.—In two months.

To Andrew Shoolbred, of Jermyn-street, in the parish of St. James, in the county of Middlesex, tailor; for certain improvements on, or a substitute for back-stays, and braces, for ladies and gentlemen; chiefly to prevent relaxation of the muscles. Dated August 18, 1825.—In six months.

To Philip Taylor, of the City-road, in the county of Middlesex, engineer; for certain improvements in making iron. Dated August 18, 1825.—In six months.

To Peter Williams, of Leeds, and James Ogle, of Holbeck, both in the county of York, cloth manufacturers; for certain improvements in fulling mills, or machinery for fulling and washing woollen cloths, or such other fabrics as may require the process of felting or fulling. Dated August 20, 1825.—In six months.

THE

TECHNICAL REPOSITORY.

XXXIX.—*On Screw-Stocks, Dies, Taps, Screw-Plates, &c. By the* EDITOR.

[*Continued from page* 185.]

Mr.* PETER KEIR'S *large screw-stock, dies, and cutter, for square-threaded screws.—Mr. Keir was formerly largely employed in mounting pieces of artillery upon their carriages, and had occasion for a considerable number of square-threaded screws, for their elevating parts; he, therefore, thought it well worth his while to construct the screw-stock, dies, and cutter, we are about to describe, with a view to facilitate the making of those screws, and which purpose they completely answered; the greater part of the work being performed by the cutter, and the dies only serving to indent the cylinder to be cut, sufficiently to guide the cutter in its work.

In plate VII. we have given an accurate and minute detail of one of these large screw-stocks, as fitted up with a pair of dies and a cutter; together with the various parts composing it, shown separately, on a scale of one fourth their real size.

Fig. 1, is a top view of the screw-stock, &c., but without its handles (they being omitted for want of room in the plate, the whole length of the instrument being about six feet). Fig. 2, a side view, with one of the handles, and a portion of the stock removed, in order to show the dies and other parts more distinctly. Fig. 3, a section of the stock, and one of the dies, taken at the dotted line A B, in fig. 1. And fig. 4, a cross section, through the middle of the stock, &c. at the dotted line C D, in that figure. In all these figures, as well as in the others, to

be hereafter referred to, the same letters indicate the similar parts.

The construction of the stock, and the manner of fitting the dies into it, having already been fully described*, we have now only to show the ingenious mode in which Mr. Keir has adapted the cutter to the dies, and the alterations he has made in them, to fit them for making square-threaded screws. E E are the two hard steel cylinders, upon which the dies slide, as shown in fig. 3; these cylinders have brass milled heads, F F, &c. at one end of each of them, by which to pull them out of the stock, when necessary, to take out the dies. G and H are the dies; these are made considerably thicker than usual, in order to retain the cylinder to be cut into a screw, more steadily within them; and the portions of threads *within them are much shallower than commonly made*, they being, as above-mentioned, intended only to indent the cylinder slightly, yet sufficiently so to guide the cutter in its work of deepening the grooves. The die, G, has also that portion of thread, from its centre at I, (see fig 3), to its termination on the side, removed or cut away, thus forming a cutting edge in the middle of the die. Upon the other die, H, the cutter, J, is affixed, and guided in the following manner. In fig. 5, this die, H, is shown separately, as prepared for the reception of the cutter, J, it being filed aslope upon its top, from K to L, agreeably to the inclination of the thread of the screw, and a gap made across the middle of its top for the cutter, J, to lodge in; this is shown in the top view fig. 1. Fig. 6 shows this die and cutter, having also a covering plate, M, upon it, bound down by two screws, to keep the cutter, J, steady. This plate, M, is shewn separately in fig. 7, which is a top view of it, and in fig. 8, which exhibits its under side, having a shallow gap made across it, to receive the upper side of the cutter, J, within it. The cutter, J, is also shown separately in fig. 9, which is a top view of it, showing also

* See page 183

the inclination of its edge, at N, in fig 10, which is a side view of it; and fig. 11, being an end view thereof. The cutter, J, is urged forwards from time to time, when in action, by the screw, O, which is guided in the staple, P, affixed to the back of the die, H, by two screws. This staple is shown in figs 12 and 13, as affixed to the die; and an inside view of it, separately, in fig. 14. Q Q, are the two screws which close the dies upon the cylinder to be cut. R, fig. 15, is a cylindrical rimer, shown in section, in fig. 16, which is used by Mr. Keir in finishing the grooves in the edges of the dies for this stock, in their places in the stock, as before described; the point of it is tapered away a little. Fig. 17 is one of the steel cylindrical pins, E, and its brass head, F, shown separately.

Mr. Keir thinks it would be an improvement to make cutting teeth upon the upper parts of the leading edges of the dies, as shown in fig. 18, at S S, which represents part of a die, on a larger scale, and which might act so as to reduce the metal into slender filaments, insteadof broad slices, as at present, and greatly facilitate the action of the dies. Their lower parts he would, however, leave square and entire, as usual.

Mr. Keir made his screw-stocks *of the best Swedish iron, case-hardened.* He has four of them, all of different sizes: these last described being the largest.

In our continuation of this article, we shall give some improved methods used by other intelligent mechanics of our acquaintance, in making square-threaded screws, and which have always been considered as among the most difficult to cut.

XL.—*On the Blowing of Air into Furnaces by a Fall of Water. By the late celebrated* Wm. Lewis, *M.D.*

[*Continued from page* 174.]

In Foix, in France.—In the county of Foix, the blowing machines, as described by Reaumur, in the "*Art des*

Forges," above quoted, are considerably different from the foregoing. The pipe is rectangular, and the part above the choak divides into three funnel-shaped partitions. On the top is a reservoir, or cistern of water, and two of the partitions, close on all sides, pass up above the surface of the water, for carrying down air, and thus supplying the place of the lateral air-holes: the water enters into the third partition, which is the only space between the two foregoing, and which has but two sides, formed by the two opposite sides of the others.

The author makes the principal difference of these machines from those of Dauphiny, to consist in this disposition of the upper part; but the plate annexed to his description, shows another which is, perhaps, more material to the success of the instrument. The whole height of the pipe, including that of the water in the reservoir on the top, is, according to the scale, twenty or twenty-one feet; and the choak, or narrow throat, is almost down to the middle of this height, so that the water issues through the choak with a velocity which it acquires from a pressure of about ten feet, which is greater than in the machine of Dauphiny in the proportion of about eleven to six: the quantity of water seems, also, to be much less, in proportion to the width of the pipe; the great pressure, probably, occasioning it to spread, so as to fill a larger bore than it could do when falling with less velocity.

Two pipes, divided in the same manner at the top, are fed by one reservoir: the lower ends of the pipes enter into one large oblong box, from which the air and water pass out, as in the foregoing machines described.

At St. Pierre, in Languedoc.—M. Barthès, in a curious paper, printed in the third volume of the "*Correspondence of the French Academy,*" gives a minute description, though, in some respects, not so clear as could be wished, of a blowing machine at the forge of St. Pierre, on the river Obriou, which he looks upon as one of the most perfect of the instruments of this kind. Its general

structure is nearly the same with that of Foix, but the height of water above the choak much less.

The upright pipe is square, about nine feet high, and somewhat more than seven inches wide. Into its top are inserted, at opposite sides, two pyramidal air-pipes, widening upwards, and passing up obliquely through a basin of water four feet high. The space included between the pipes, at their lower ends, under the basin, is a kind of hopper, into which the water enters through two apertures in the bottom of the basin: to each of these apertures is fitted a piston or stopper, hung to the end of a lever, by which it is raised, more or less, according as more or less water is required. Two of these instruments are furnished with water from one basin; and the lower ends of both enter into one air-vessel, which is near five feet high, about six and a half long, near three and a half wide at one end, and not quite two at the other. The stones for the water to fall upon are somewhat less than four inches and a half distant from the pipes: the water runs off through two rectangular apertures at the bottom, each about eight inches and a half wide, and near six inches high: the pipe which carries off the air is an inch and a quarter in diameter at the small end, where it enters the furnace.

The obscure part of the description relates to the hopper, and the apertures by which the water is discharged from it into the perpendicular pipe. The hopper seems to be divided into two rectangular openings, through which the water runs into the two hoppers, each of them about seven inches and a half long, and in width five inches and a half, measured on the level of the bottom of the reservoir, which is reduced to four and a half at the extremities of the air-pipes, where the hopper also terminates.

The author observes, that in this machine the water issuing from the hopper is necessarily reduced into drops. To satisfy himself more fully of this particular, he took a tin vessel, eight inches and a half square, and six and a

half high; in the middle of the bottom he cut a rectangular opening, about an inch and a tenth long and eight inches wide: to the two long sides of the slit he soldered two tin plates, inclined towards one another, and a third across them. These apertures, he says, represent those of the machine, when the stoppers are drawn up; and water, put into this vessel, came out always, during the whole time of its running, in streams, which struck against and crossed each other; and which, after spreading, were reduced into drops.

In this illustration of the machine, though it seems clear, there must be something which escapes my apprehension. Having cut an aperture of the above dimensions, in the bottom of a vessel, I fitted to each of the larger sides a plate, half the width of the aperture; both of which plates were moveable, and kept at different inclinations by means of the third plate, which passed across the middle of the two. The vessel being filled with water, I could not observe, as indeed was expected, the least crossing of the streams that ran through it: on the contrary, greatest part of the water issued in two opposite directions, horizontally, from between the ends of the plates.

Experiments and Observations for the Improvement of the foregoing Machines, and for Establishing their Principles of Action.

I. *Of the quantity of water they require, and the quantity or force of the air they afford.*—The quantity of water may be estimated with sufficient exactness from the height of the water in the funnel or basin at the top, and from the width of the choak or throat of the funnel, through which it is pressed by the force of a column of that height.

Desaguliers found, by an experiment often repeated, that the quantity of water running through a square inch hole, twenty-five inches under the surface, is five tons and a fifth in an hour, the ton containing two hundred and fifty-two gallons. The quantities discharged through equal

holes at different depths, being as the square roots of the depths, and the quantities through different holes, at equal depths, being as the areas of the holes, it will appear, on calculation, that in the machine at Lead-hills, whose funnel is five feet high, and its throat three inches and a half in diameter, the expence of water is somewhat more than seventy-seven tons in an hour, or near three hundred and twenty-four gallons in a minute; and that in the machine of Dauphiny, where the height of water in the funnel is is only about half as great, and the bore of the throat a little wider, the quantity of water is about two hundred and sixty-six gallons in a minute. Perhaps the real quantity of water may be somewhat less than this calculation given, as the resistance of the compressed air may occasion some retardation of the motion. Of the other machines, the descriptions are too imperfect or obscure for any computation to be made from them.

The water issuing from the narrow throat of the funnel with great velocity, is said to spread so as to fill the wider bore of the pipe, and to become frothy, from the mixture of air with it. The jet, thus enlarged, may be conceived as consisting of a multitude of slender streams or drops, the intervals between them being occupied by air, which is continually supplied through the air-holes, and pushed down by the succeeding drops or streams. It has therefore been reckoned, that the volume of air which passes down the pipe, must be as much greater than that of the water, as the transverse area of the jet, when spread and reduced to drops in the pipe, is greater than when it passed through the throat of the funnel. Circles being to one another as the squares of their diameters, the area of the pipe of the Lead-hills' machine will be to that of the funnel's throat, as eighteen to twelve and a quarter: the volume of air, according to the above principle, being to that of the water in the same proportion, and the quantity of water nearly 324 gallons in a minute; the quantity of air in a minute should be about 475 gal-

lons and a half, or 134,000 cubic inches, or 176 cubic feet of air in a minute: so that, by this way of reckoning, the Dauphiny machine, with nearly a fourth less water than that of Lead-hills, should produce more than a double quantity of air.

But though this method of computation appears specious, it is not, perhaps, to be much depended on; air, in different circumstances, occupying very different volumes, in virtue of its great compressibility; nor is it certain that the bores of pipes are sufficiently filled, so as to carry down the full quantity of air. It may be presumed that the air, intermingled in the jet, is always in some degree compressed by the water, so that the interstices between the streams or drops contain more air than equal spaces of the atmosphere. It may be judged, however, from the above comparison, that the wider the pipe is, in proportion to the funnel's throat, provided the water running through the throat will spread through the whole extent of the bore of the pipe, the more air will be carried down.

M. Barthès, the only person I know of who has examined these machines philosophically, and endeavoured to improve them, gives a method, in the memoir above quoted, of comparing the proportional quantities or forces of the air, in different blowing machines, on another principle. From considerations, too abstracted to be here particularized, he deduces a general rule, that the produce of air will be, in all cases, in proportion to the quantity and velocity of the water: so that the quantity of water, and height of the fall being given in two machines, and the volume or force of the air in one of them being measured by experiment, the volume or force of air in the other may be determined by the rule. Accordingly, he made several experiments of this kind, in two machines; measuring the force of the air, when the water in the basin was at different heights, by the weight which the blast, acting on the arm of a balance, was capable of raising. Taking one of these experiments for a standard,

he computed by the rule, what the results of the others ought to have been; but the experiments and calculations ill agreed together. And, indeed, the rule does not seem to be applicable, but in circumstances which can scarcely be expected to occur; for it supposes the machines to be all perfect, and every drop of the water to have its utmost effect, or to carry down with it as much air as it is capable of doing, which cannot be admitted to be the case in any of the blowing machines yet constructed.

In the "*Art des Forges*," are mentioned some observations of Reaumur, of the quantity of air afforded by the wooden bellows. He finds that those used at the iron furnaces yield 98,280 cubic inches, or upwards of five cubic feet of air, at every stroke; and, including the two bellows which act alternately, 240 strokes in a quarter of an hour; which, on a reduction of the French measures to the English, make 1,301,896 cubic inches, or upwards of 753 cubic feet in a minute: this quantity exceeds that which the foregoing calculation gives, for the machines of Dauphiny, above four times; and, therefore, four of the machines should scarcely be able to supply the iron furnace with so much air as the wooden bellows do; whereas two or three are said to be sufficient. Again, the bellows of the iron finery and forge were found to give two thousand and fifty-one cubic inches and a third at each stroke, and four hundred and twelve strokes in a quarter of an hour; whence the quantity of air in a minute is 458,247 cubic inches, or somewhat more than 265 cubic feet; this is greater than the calculation of the water machine, in the proportion of about three to two, though one of the water machines is found to supply the office of the bellows.

It is not to be supposed that the quantity of air which furnaces require, is confined to any such precise limits, as that two bellows, from their being found to answer sufficiently for one kind of furnace, or even two for one individual furnace, can be concluded to yield quantities of air exactly or nearly equal. The above differences are, per-

haps, as little as can be expected in comparisons of this kind, where the effects compared are so indeterminate.

As to the water machines, it is plain that the quantity of air carried down cannot be greater than the spaces between the drops, or divided streams in the pipe, can contain; and that though the air in these spaces must be considered as being compressed to a certain degree; yet it cannot be supposed compressed into two-thirds of its natural volume, which would be necessary for making the calculation of the wooden bellows and the blowing machine to agree; because such a condensation would require the weight of a column of water of eleven or twelve feet, or the third part of such a column, as is equivalent to the pressure of the atmosphere; whereas, in the Dauphiny machine, though the air was pressed down with the full force of the column of water above the choak, the height of this column is less than three feet, and could not condense it more than one twelfth part.

In what manner Reaumur computed the air of the wooden bellows, we have no account; it is probable that he judged, as others have done in the same cases, from their capacity; supposing the whole quantity of air they contained to be delivered at every stroke. If so, we can lay no stress on the computation, for neither the wooden nor the leathern bellows, deliver their full contents of air; a considerable space remaining full of air, when the bellows are closed; and this space containing considerably more air than an equal volume of the atmosphere, on account of the air being condensed in them by the pressure of the bellows. I have been informed by a judicious workman, that the bellows of the iron finery retain commonly a third, and sometimes half of their air; and that when lined with wood, so that as little vacant space as possible might be left, he found them to blow much stronger than before.

The strength of bellows is best judged from the force of the blast itself, and this force may be determined in the method recommended by M. Barthès, already men-

tioned, by the weight it is capable of raising. He found that in the blowing machine of St. Pierre, the force of the blast issuing from a hole of an inch and a third in diameter, raised the arm of a balance loaded with a weight of twenty-five ounces and a half. He gives some other experiments of comparing the proportionate diminution of its force, according to the diminution of the height of the water, which I shall insert in the original French measures, to avoid unnecessary fractions. The above force of twenty-five ounces and a half, is the maximum of this machine, produced by the full quantity of water in the basin, or a height of forty-eight inches above the choak: with a height of forty-one inches, the weight raised was twenty-two ounces; with a height of thirty-two inches, nineteen ounces: with a height of twenty-eight inches and a half, seventeen ounces and a quarter; with twenty-four inches and a half, fifteen ounces and a quarter; with nineteen inches, twelve ounces and three eighths; with sixteen inches and two-thirds, ten ounces and a quarter; and with a height of thirteen inches and a half, eight ounces and three-quarters.

It may be observed, that in some of these experiments the water must have been employed to disadvantage; and that, by increasing the height of the water much farther than the above limits, in the same machine, we could not expect to produce proportionate augmentations of the force of the blast: for if a certain quantity of water, running with a certain velocity through the choak, be supposed to fill the bore of the pipe, a less quantity, with a less velocity, must leave a vacancy, which will suffer part of the air to escape; and a greater quantity, with a greater velocity, must have some part of it spent ineffectually, for want of sufficient room to spread. Some experiments, mentioned hereafter, afford a clear proof of this.

[*To be continued.*]

XLI.—*On the Exhibition of the Belgic and Dutch Manufactures, at Haarlem; on the last Exhibition of the specimens of French industry, at the Louvre; and on the Manufacture of Steam-Engines in France.*

THE town of Haarlem has hitherto been celebrated only for its claim to the invention of printing, its siege, its organ, and its tulips. This year it has possessed attractions of a different kind, and has been visited by greater crowds of people, both natives and foreigners, within the space of six weeks, than during any six years, since the days of the Duke of Alba. The source of these attractions was an exhibition of specimens of all the Belgic and Dutch manufactures, for the purpose of encouraging manufacturing industry by praise and premiums. The King of the Netherlands, who is himself a merchant, and who holds shares to a great amount in two new commercial and ship-building companies, determined, last year, to have a grand show of manufactured articles, of all sorts, from a steam-engine to a brass pin. This idea of exhibiting specimens of manufacturing skill, in a kind of general collection, was borrowed from the French; who, before and since the return of the Bourbons, have had their periodical *expositions*. The King of the Netherlands followed up the French display of 1819, by one at Ghent, in 1820; and that of the Louvre, in 1823, led to the Belgic decree of 1824, which ordered the manufacturers to prepare for gold medals and complimentary speeches this summer, at Haarlem. His Majesty had thus a double object for the show of this year: in the first place, by selecting Haarlem, he wished to prove to the Dutch that he had no partialities in favour of Belgium; and, in the second place, he was anxious to convince both Dutch and Belgians that they can be as independent of France, as France is of them; that they are as industrious and skilful as their southern neighbours; and that they need not now dread

the rivalry, or court the connexion, of their former masters. Whether he has attained either of these points remains to be proved. Certainly those who, in 1823, traversed the *forty-two salons* of the Louvre, so copiously garnished with the choicest specimens of handicraft and art, from the workshops and manufactories of a great and wealthy nation, —who witnessed what the French called their "*fête* of industry,"—would require a good deal of charity, if a foreigner, or of patriotism, if a native, to find in the scanty and unostentatious distribution of the articles, spread out in the barracks of Haarlem, any subject of comparison with the brilliant spectacle, the gorgeous bazaar of Paris! They were both, however, exhibitions of the works of industry; and the successful candidates in both attracted the attention of their fellow citizens; and that, probably, was enough to satisfy the Dutch.

In the exhibition of Haarlem there was no want of emulation. The King's decree, appointing the time and place of the show, is dated the 28th of June, 1824. The manufacturers had thus a year to prepare for the trial, which was appointed for the month of July last. The government engaged to bear all the expenses of transporting the articles from the manufactories of their proprietors to the place of exhibition. Judges were appointed to decide on the qualities of the specimens; and medals of gold, silver, and bronze, were ordered to be struck, as prizes for the successful candidates. The catalogue, in which these specimens are enumerated and arranged, makes up a book of nearly 400 pages; the exhibiting manufacturers amount to upwards of a thousand; the separate packages, or samples, exceed 6,000; and, probably, the number of visitors attracted to Haarlem, during the six weeks of the show, did not fall short of 150,000. It was intended to conclude at the end of July, but the concourse of eager spectators was so great, that his majesty, by a royal decree, kept it open till the 10th of August.

Some days before its close, he himself proceeded from Brussels to the Hague, and from the Hague to Haarlem, spent a day in traversing the rooms, and inspecting the objects of the exhibition, conversed with the most eminent of the exhibitors, and left his Minister of the Interior to distribute the prizes. Accordingly, on the 10th of August, his excellency M. Von Gobbelschroy, the representative of the king, accompanied by the local authorities, and the judges of the exhibition, entered the cathedral, where a kind of throne, adorned with the national colours, was prepared for him, and, after a suitable discourse from the pulpit, upon the industry and the prosperity of Holland, by the Protestant clergyman, Mr. Onder de Wyngaard Couzins, distributed eleven gold medals, and a great variety of silver and bronze ones. Every body was, of course, delighted; and the successful candidates returned to their homes, "hurling defiance" against Birmingham, Manchester, Sheffield, London, Sedan, Louviers, and Lyons.

Having thus given a brief description of the circumstances connected with this exhibition, it may be proper to make a few observations on the quality of the articles produced. The fabrics in which the Netherlands' manufacturers excel are soon told. They do not come up to the French in silk; they fall short of the English in hardware and cotton; and they cannot compete with the Germans in some kinds of woollen and linen. The worst shops of Manchester could not have presented a more wretched exhibition of cotton cloth and cotton twist than we saw in the barracks of Haarlem! The display of cut crystal was very scanty, and not very striking; the cutlery was unworthy of notice, by an Englishman; and the different prices of ornamental clock-work, and articles of household furniture, fell very short of those of France. There was not even a single specimen of shawls, which made such a striking item in the exhibition of the Louvre.

In short, the only things in which the Netherlands exhibition excelled, were in the broad-cloth of Verviers, and some specimens of linen and lace.

To these observations we add an account, which a gentleman of great practical knowledge and strict impartiality drew up, of the last French exhibition:—

The specimens of French industry, exhibited at the Louvre, may be classed under two heads:—objects of mere luxury, of which the demand is necessarily limited; and objects of general consumption, which may be of importance in the internal commerce of a country, or in its foreign trade.

Manufactured articles of the first class, are of comparatively small interest to an Englishman; not so the specimens of the second class. In the consideration of the latter, the inquiry is naturally directed to the two great questions—of improved skill in manufacture, and economy in the production; and, as connected with the qualities of improved skill in manufacture, the attention is immediately fixed on the improvement in machines; but chiefly on the steam-engine, as the animating principle of modern machinery. Strange to tell, there was not any thing of the kind, in the last or present "*exposition*," which could satisfy the inquirer under this head! There are, in the the vicinity of Paris, two great establishments for the manufacture of steam-engines; one at Charenton, in which Mr. Aaron Manby, late of the Horseley works, near Birmingham, is concerned; the other, and more important one, under the firm of Perrier and Co., at Chaillot. *The workmen at Charenton are all English, and whatever may be the ultimate chance of success with this establishment, it can only be regarded as exotic, and liable to many hazards of failure, before it shall have taken root!* Perrier's establishment, on the contrary, may be looked upon as French; the capital is French, and the workmen are French or Germans; and if Mr. Jennings and Mr. Edwards, partners in the concern, are English, at least they do

not work with English hands. Independently, however, of this distinction, the establishment itself is of more interest, as respects its powers of production. Mr. Edwards was the partner of Mr. Arthur Woolf, who so greatly improved on the principle of the high-pressure engine; and he has given to this establishment the benefit of his great practical knowledge and experience.* *The progress, accordingly, within the last four years, has been surprisingly rapid:* and if the engines are not as cheap as in England, at least they are not much inferior in workmanship; 220 men are in constant work on the premises, and perhaps ten times that number are employed out of doors. The number of engines turned out within twelve months, has been forty; and they have orders which will occupy them eighteen months more. At this moment they are making two on Woolf's principle; one of 80-horse power, for a rolling mill, near Paris, the other a lifting engine of 200-horse power, for a mine. The principals admit that they cannot obtain nearly the same results, from a given number of French workmen, as of English workmen in England; that they find it impracticable to economize labour, as they would in England, by the system of subdivision, under the superintendance of foremen, in whom they could confide; and that, whatever difference there may be in the skill of the workmen, they must all be subjected to the same strict inspection. In fine, that the heads of the concern are the only efficient intendants.

It may here be remarked, *that the English workman is far from being of the same value in France as in his own country!* The temptation to indulge in drinking, from the cheapness of wine and spirits, and the impression that his services cannot be dispensed with by his employers, render him so far intractable, that there is small danger that establishments, dependent on English workmen, will

* For an account and engraving of the excellent *allesoir*, or boring-machine, used in this manufactory, see vol. II. page 111. of the *Technical Repository*.

long subsist in France! The experiment was tried at Chaillot, and early abandoned.

It is not expected that steam-engines will be made at Paris at as cheap a rate as in England, or that there will be ever the same economy in employing them as substitutes for labour; but, if the government are wise enough to leave the country at liberty to profit by them, wherever they can be beneficially used, there is no doubt that the results to industry will be highly important. Hitherto, however, the administration of the interior has evinced a disposition to thwart the ingenious and enterprising directors of the establishment at Chaillot; more, perhaps, from the spirit of interference, which requires that the government influence should be felt wherever there is life or movement, than from a desire of checking improvements in machinery; not but that strong prejudices exist against machines in two classes of reasoners: those who believe that a people, "*en sabots*," may be more easily governed than manufacturers, and therefore oppose the manufacturing system generally; and others, who, favouring the manufacturing system, believe, nevertheless, that every improvement in machinery, by abridging labour, is necessarily of prejudice to labourers. The partisans of both systems are numerous, and their influence will be at all times felt, to the prejudice of manufacturing industry; *at least, on the scale of grandeur in which we see it in England!*

Turning the attention from machines to the specimens of manufactures, it is at first arrested by the broad-cloths, in which the French have been such successful competitors with us. They appear, in general, more soft and glossy than at the last *exposition;* and the finer cloths, made by M. Ternaux, are rather cheaper. M. de ——, of the *coti-droit* of the Chamber of Deputies, and one of their most distinguished members, has been eminently successful as an agriculturist, in the naturalization of the merinos in France. In his opinion, and no man is more capable than himself of forming a correct judgment as to

the progress of the woollen manufacture, from the attention he has bestowed upon it, the superior cheapness of these fine cloths is to be attributed, exclusively, to the stagnation of trade; while the softness is produced by the greater use of the Saxon, and even lambs' wool. He has not sold this year, nor have any of the great merino wool growers sold a single fleece, although he would gladly have accepted thirty sols a pound; and he remarks, in confirmation of the greater use of lambs' wool, that, contrary to all former precedent, it bears a higher price than the older wools. *Whatever the cloths may have gained in softness of texture, they have lost in durability*; and it is very problematical whether, in the end, they will be found to be cheaper. Flannels, also, present an appearance of greater beauty than formerly; but the prejudice in favour of the English (Welsh) flannels continues undiminished among the French, although they cannot yet have given their own, of the improved quality, a fair trial.

Monsieur —— (partner in the house of ——, and Co.), who, from his extensive connexion with all the great manufacturers, and the magnitude of his own commercial concerns, has ample means of ascertaining whether, within three or four years, the manufacturing industry of the country has made any progress, is of opinion, that if, in some articles of mere luxury, such as cachemere shawls, cut glass, ornamental steel, *bronze d'or*, and minor objects, there has been improvement; yet that all their greater manufactures in woollen, cotton, linen, silk, and hardware, are stationary, unless M. Ternaux's assertion, that he has improved the manufacture of his finer broad cloths, be admissible*. It is true, that in two of the smaller cotton manufactories, some of the late improvements in machinery have been imported from England; but, nevertheless, Mr. —— still considers that, in this branch of manufacture, they are stationary.

* The purchasers of these broad cloths declare that they will not bear damping.

XLII.—*On the comparative Advantages of the Labour of Horses and Oxen, in Agriculture; as experienced in his late Majesty's experimental farms at Windsor; with other particulars of those farms.* By NATHANIEL KENT, *Esq.**

SIR, *Craig's Court, October* 30, 1798.

UPON mentioning to you some time since, that there had been some practices in husbandry, on his majesty's farms under my superintendance in Windsor Great Park, which I conceived were not generally known; and upon your giving me reason to think the Society for the encouragement of Arts, &c. from its laudable desire to communicate to the public every thing that promises advantage to it, would not be unwilling to allow me a few pages in its next publication; and being indulged with his majesty's gracious permission to state any matter that I may discretionally judge proper to communicate; I am induced to lay before you a few particulars, which some gentlemen and farmers, under similar circumstances, may perhaps think deserving notice.

But before I enter upon any particular description of what I have to offer, it will not, perhaps, be uninteresting to the Society, to know the grounds upon which his majesty's large system of agriculture has been founded.

In the year 1791, the Great Park at Windsor, about 4,000 acres, fell into his majesty's possession. It might truly be called a rough jewel. The whole, as a natural object, was grand and beautiful, of a forest appearance; but the parts were crowded and indistinct. The soil was various, some parts clay and loam, and some sharp gravel or poor sand; a great part of the former was covered with rushes and mole-hills, and the latter with fern and moss.

About 1000 acres of the lightest part were separated from the rest at one extremity, and formed what is called

* From Vol. XVII. of the *Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.*

the Norfolk farm: about 400 acres more at the other extremity, of a good loamy soil, were separated and called the Flemish farm, both being named from the nature of the husbandry meant to be adopted upon them.

The rest (about 2,400 acres) remains still in plantations and park; and though so much reduced, yet, from the improvements which have been made upon it, is now capable of carrying more stock than the whole 4000 acres did before. All the unsound wet parts have been drained by the Essex mode, so as to be rendered firm, and productive of an improved herbage. The mole-hills have been levelled, chiefly by dragging, and the coarse and mossy parts fined by repeated harrowing and rolling, (being one of the first improvements upon park land of this description); besides which, a variety of beauty has been laid open, by clearing the valleys and low parts, to give a bolder effect to the woody scenes upon the higher ground; and by making judicious openings, so as to break straight lines, and separate parts that were in some places too heavy and samely; so that the same extent of land has now not only a much larger appearance, but exhibits a much greater variety of ground. The truth of this every impartial person who knew the place before his majesty caused these improvements to be made, must allow. I have only to add, that though prejudice may have taken up an idea that there has been too great a sacrifice of timber in effecting these improvements, truth will deny it. There has not been a tree taken down, but what was either in decay, or removed to give room for the growth of others, or to set them off to greater advantage in picturesque appearance.

I come now to the object in view, as before hinted, which is to state the motives which I am inclined to think induced his majesty to adopt the farming system upon so large a scale, and next to show the result.—These I conceive were chiefly to create useful labour for the industrious poor in the neighbourhood, and for trying experiments in agriculture, to excite imitation where success might encourage it.

The Norfolk farm borders on that extensive waste called Bagshot-heath, hitherto considered too barren for cultivation, though large tracts of a similar quality have been long since rendered useful to the community in the south-west part of Norfolk. Arable land of this description is generally managed there under a five-course shift: first, wheat; second, turnips; third, barley, with seeds, which continue laid two years. But as the seeds turn to very little account after the first year, his majesty's, which though a five-course shift likewise, of one hundred acres in a shift, is upon a much improved course of cropping: as thus—first, wheat or rye; second, the irregular shift; third, turnips; fourth, barley or oats; fifth, clover. The irregular shift, which is of great use on a light land farm, may perhaps want a little explanation. It is meant to be partly productive, and partly preparative. Forty acres of it are sown with vetches, to be fed off; forty are sown the latter end of August with rye, for early feed the next spring for the ewes and lambs: the remaining twenty acres are planted with potatoes, and the whole comes round for turnips the next year.

From the advantage of running sheep in the park, this farm has been brought surprisingly forward, considering the short time it has been cultivated; and a great part of it, which produced nothing but heath and moss, and would have been dear at five shillings an acre to rent, now produces crops worth more than the original fee-simple of the land.

Brevity checks me from going farther into a general description; but the following particulars may deserve notice.

The comparative advantages of the labour of horses and oxen have been for some time under the consideration of the public. His majesty has unquestionably tried the latter upon a larger scale than any other person, as he does not work less than one hundred and eighty oxen upon his different farms, parks, and gardens, and has found them

to answer so well, that there is not now a horse kept. Upon the two farms, and the great park, two hundred are kept, including those coming on and going off. Forty are bought in every year, rising three years, and are kept as succession oxen in the park; one hundred and twenty are under work; and forty every year are fatted off, rising seven years.

The working oxen are mostly divided into teams of six, and one of the number is every day rested, so that no ox works more than five days out of the seven. This day of ease in every week, besides Sunday, is of great advantage to the animal, as he is found to do better with ordinary keep and moderate labour, than he would do with high keep and harder labour. In short, this is the first secret to learn concerning him; for an ox will not admit of being kept in condition like a horse, artificially, by proportionate food to proportionate labour.

These oxen are never allowed any corn, as it would prevent their fatting so kindly afterwards. Their food in summer is only a few vetches, by way of a bait, and the run of coarse meadows, or what are called leasows, being rough woody pastures. In winter they have nothing but cut food, consisting of two-thirds hay and one-third wheat-straw; and the quantity they eat in twenty-four hours is about twenty-four pounds of hay, and twelve of straw: and on the days of rest they range as they like in the straw-yards; for it is to be observed, that they are not confined to hot stables, but have open sheds, under which they eat their cut provender, and are generally left to their choice to go in and out. Under this management, as four oxen generally plough an acre a day, and do other work in proportion, there can be no doubt but their advantage is very great over horses, and the result to the public highly beneficial.

The oxen which are brought on in succession, run the first summer in the park, and in the leasows and temporary straw-yards in the winter; by which temporary straw-yard

I would have it understood, that they are made in different places, so that the manure which they make may be as near to the spot where it is wanted as possible.

The forty oxen which go off are summered in the best pasture, and finished with turnips the ensuing winter. The usual way has been to draw the turnips, and to give them either stalled or in cribs placed in the yard, with plenty of straw to browse and lie upon; but last winter an experiment was tried, which answered extremely well, and will be again repeated next winter: this was, penning the oxen by day upon the turnip-land, in the manner that sheep are penned, with this only difference, that the turnips were thrown up into cribs, instead of being left to be trodden into the ground: and in the nights they were driven into a yard, with a temporary shed well littered with rushes, fern, and leaves, and turnips and barley-straw given to them in cribs. They thrived very fast, and every one of them made at least eight loads of good muck in the night-yard, besides the benefit done in treading and dunging on the land in the day-time, which was very great, the soil being very light. The result of the ox system is, that charging the ox for his agistment the first year, for the value of the grass and turnips the last year, and putting what he has in three intermediate years as an equivalent for his labour, after every allowance for risk, each ox will pay at least twenty per cent. profit. In what instance does a horse produce so much?

I do not allow that the ox can be used on all soils; upon a very stony soil he cannot: nor can the horse in all places be wholly excluded from husbandry; but every occupier of a large farm may at least use some oxen to very great advantage. They are all worked at Windsor in collars, as their step is found to be much more free than when coupled together with yokes, and they are found to do their work with much greater ease in collars than in yokes, which ought every where to be exploded.

The different kinds of oxen are in some measure suited

to the soil.—Upon the Norfolk farm, which is a light soil, the Devonshire sort are used; upon the Flemish farm, where the soil is strong and heavy, the Herefordshire; and in the park, where the business is carting, harrowing, and rolling, the Glamorganshire. They are all excellent in their different stations.

It may not be improper to mention a very simple method which has been discovered, of first training them to the collar, which is nothing more than putting a broad strap round their necks, and fastening one end of a cord to it, and the other to a large log of wood, and letting the ox draw it about as he feeds in pasture, for three or four days before he is put into harness, by which means he is very much brought forward in docility.

I have before observed, that twenty per cent. may be considered as the average profit of an ox; stating them to be bought in at 10*l.*, and allowing them to sell for 25*l.*, taking off 10*l.* for the two years they are not worked; but last year beans being of very little value, they were kept longer than usual, by being stall-fed with bean-meal, which answered very well, as they were brought to an average of nearly 30*l.*; and one of them, a Glamorganshire ox, originally bought for 8*l.*, and, from his compact round make, always called the little ox, thrived to such a surprising degree, that he became too fat to be able to travel to Smithfield, and was therefore sold to Mr. Charlwood, a neighbouring butcher, for 47*l.*

Next to the advantage obtained from oxen, as much benefit as possible has been endeavoured to be derived from sheep, by means of the fold. Two ewe flocks are kept, of four hundred each: the soil being light and dry, admits of winter-folding (except when the weather is wet) upon the young clover; a practice much to be recommended, as it is productive of a great crop of clover, and prepares the land the ensuing autumn for a crop of wheat, without any further assistance. Another excellent practice is folding upon light land, in dry weather, immediately

upon the sowing of the wheat, which may be put forward or put back, a fortnight or three weeks, on that account; and it is not amiss to have the fold rather large, and to give the sheep a turn or two round the fold in a morning before they are let out, to tread and settle the land, which does a great deal of good, over and above their dung.

A third method of folding has been found to answer almost beyond description. This was first tried in the winter of 1793; but from an idea of the shepherd, that it injured the sheep, has been since disused: but as there is good reason to believe that there was no just ground for such an opinion, it is meant to be revived next winter.

A dry sheltered spot is selected, and sods of maiden earth, a foot deep, are laid over the space of a very large fold. It is then bedded thinly with rushes, leaves of trees, fern, moss, short straw, or stubble; and in hard or wet weather, the flock, instead of being penned upon the clover in the open fields, is put into this warmer fold, where the usual quantity of hay is given to them in racks; and every night they are so penned, the fold is fresh littered. When this has been continued, at intervals, during the winter, a layer of lime, chalk, rubble, or ashes, six inches thick, is spread over the whole surface, and when it has heated together, about the month of April, the whole is turned up, and mixed together, and makes the very best manure that can be used for turnips.

I have been particular in describing these methods of folding, as they are not common in any place, and in others entirely unknown, and to gentlemen who have parks and large plantations which afford abundance of leaves, this hint may be the more deserving attention.

Upon the Norfolk farm the land not having been yet marled or clayed, the clover is apt sometimes to fail, which is also the case elsewhere, upon the same sort of land. When this happens, his majesty does what every other person in his situation should do; instead of letting the ground remain unproductive, the next year it is

sowed with vetches, which are nearly as valuable as the clover, and wheat always grows remarkably kind after them.

As to implements, the Norfolk plough is chiefly what is used: and upon a light soil, it is certainly preferable to any other. It ploughs a cleaner furrow, by completely moving the whole body of earth, and inverts it much better than any other plough: and to establish its superiority over the common ploughs of the neighbourhood, I need only add, that from its construction it is nearly the draught of an ox easier. There is likewise a Norfolk harrow, very useful for harrowing what are called brush turnips, or any other turnips, preparatory to their being hoed. I must be allowed, likewise, to mention the drill-roller, which consists of cast-iron rings, made at the Norwich foundry, and slipt on upon a round piece of wood, as an axletree. This is one of the best things that has ever been introduced for the preparation of the land for any sort of corn, where the soil will admit of its being used. By the corn being so well deposited, it takes better root, and at least one fourth of the quantity usually sown may be saved.

The Flemish farm, which I have before mentioned, was so named from an intention, at first, of carrying on a system of husbandry similar to that practised in Flanders, which consists of an alternate crop for man and beast; but the soil being strong and cohesive, upon trial, it has been found to answer best under a four-course shift, more like some parts of Gloucestershire; as thus—first year, wheat; second, cabbage or clover; third, oats; fourth, beans.—The quantity of arable land on this farm is one hundred and sixty acres, or forty acres in a shift. There are two things observed upon this farm, which may be worth notice:—the first is the practice which has for these two years past been adopted, by taking off the tops of the beans just as the blossom is set; this not only improves the quality, but increases the quantity, and causes them to ripen sooner, which is a considerable advantage, by giving

time to get the succeeding crop of wheat in perhaps a fortnight earlier. The other is, that of sowing clover early in the spring, among twenty acres or one half of the wheat, and bush-harrowing and rolling it in. This has produced a very fair crop of clover the next year; and the other half, after the wheat, is winter and spring fallowed, and planted with cabbage. There is a double advantage resulting from this; that one half of this shift, so managed, becomes a summer crop, and the other half a winter crop; and by observing the next year to change the parts, by sowing the clover where the cabbage was before, the clover and cabbage do not come round upon the same ground but once in eight years.

Cabbage has been tried several years, but his majesty's husbandmen never got into the right management of it till this year; but now the crop is remarkably fine.

It will not be improper to mention, that the drum-headed cabbage is the best sort; that the seed should be sown in August, the plants first set out in November, and transplanted for good in July. The next thing to be noted is their application: they are certainly inferior to turnips for fatting, but superior in the increase of milk, either of cows or ewes, and therefore they are particularly good where there is a dairy or a breeding flock of sheep: and I trust his majesty will, the next yeaning season, try an experiment, of which I have high expectation, which is to slice or quarter the cabbage, and feed the ewes with them upon such of the meadows as want manuring, which I flatter myself will be of inestimable service to the ewes and lambs, and be the means of increasing the next year's crop of hay considerably.

The true light of viewing these improvements is to consider them as a sort of new creation to the public; for, as it is a fact not to be controverted, that the reduced number of acres in the park, from their improved state, support as many deer and other cattle as the whole did be-

fore, the produce obtained from the farms is all clear gain; and as to the crop of wheat and rye from the 140 acres sown, upon the most moderate calculation, may be set at 3360 bushels, and allowing six bushels to a human mouth, this gives a yearly provision in bread for 560 people; to say nothing of the fatting-off of forty oxen, the breed of 800 sheep, and the growth of at least 5000 bushels of oats and beans; all of which, it must be observed, goes in aid of the public market, as the work is done by oxen entirely.

As more experiments are in future made, I may perhaps trouble the Society with an account of them, as I am persuaded they cannot be registered any where else, to give them the credit, and excite the imitation I flatter myself they may deserve; but for the present, I shall close my observations upon his majesty's farms, with a description of his mill, which I consider as the most benevolent thing that can be done for the poor, and which I most earnestly recommend to all gentlemen of landed property, who have like means of doing it. A small over-shot mill is erected, and worked by the waste water from the lake below the lodge, where a sufficiency of corn, two-thirds wheat and one-third rye, is ground, dressed, and given to all the labourers, at sixteen pence per stone of fourteen pounds, in quantities suitable to the size of their families, which is the first of all comforts to them, and a saving of at least twenty per cent. from what it would cost them to buy it from the mealmen or shopkeepers.

I am, sir, your obedient humble servant,

NATHANIEL KENT.

To SAMUEL MORE, *Esq. Sec.*

XLIII.—*On Prison-Labour; and on introducing the culture of Hemp, &c. into Ireland. By Mr.* WILLIAM SALISBURY.

[*Concluded from page* 182.]

THE quantity of hemp imported into Great Britain, by the returns made up to January, 1823, was 30,000 tons, which,

at the present price, would cost *upwards of one hundred and ninety-seven thousand pounds sterling*; any portion of which, or even the whole quantity, may be grown in the south of Ireland by the mere application of the labour of the poor, and at the same time be the means of bringing large tracts of ground into cultivation, which, at the present time, produce little else than rushes and food for snipes.

If, therefore, the growth of hemp is of so much consequence to Ireland at present, let us consider what it has been to Great Britain, and what it must again eventually be, should the empire be plunged into war. In the year 1810, Benjamin Tucker, esq. of the Duchy of Cornwall office, stated, that the quantity of hemp imported from St. Petersburgh, Archangel, and Riga, was 70,245 tons, and cost the importers from 90*l.* to 95*l.* per ton; so that the sum then annually paid to Russia was *three millions six hundred thousand pounds sterling!*

After a residence for a considerable time in Ireland, and a personal acquaintance with many of the most enlightened persons there, where the climate is, comparatively, more congenial to the production of tender vegetables than England; and with thousands of acres of the best land in the British empire, but which are now covered with little else than noxious weeds, or saturated with water impregnated with substances obnoxious to vegetation; also with a numerous population, which, at present, however, are wandering in nakedness, attended with all the consequences of poverty, occasioned by the want of employment; the author, with becoming humility, begs leave to offer the following *suggestions for the improvement of the South of Ireland.*

Great benefit may be derived, by all classes of society in Ireland, from the introduction of certain systems of rural economy, peculiarly adapted to that country; but with which the people there are, at present, entirely unacquainted.

* The bog of Allen alone, would produce more hemp than all the Russian imports.

Many articles extensively used in the arts, manufactures, and medicine, are now imported from foreign countries, and at much greater cost than they might be produced in Ireland.

From an investigation, purposely made by the author, to ascertain the present means of existence of the people, in the most disturbed and distressed parts of the province of Munster, he ascertained, that the mildness of the climate, and the richness of the soil, aided by a numerous population, afforded great facilities for immediately carrying into effect these improvements; whilst, at the same time, the wisdom of the legislature, in repealing the transit duties, has afforded such advantages to the Irish cultivators as were never enjoyed by any people heretofore.

Opium is now grown to a considerable extent in this country, and which, in consequence of its superior quality, sells for even more than that which is imported; and from an accurate account, lately published by the Society for the encouragement of Arts, Manufactures, and Commerce *, it appears the growers complain that their exertions are limited for want of a sufficient number of hands, (women and children), to collect the opium when ripe; they being dependent on the migrating Irishmen, after hay-time, for accomplishing this necessary part of the work!

It appears that the quantity of opium annually used in Great Britain, is 50,000 lbs.; which would require from 3 to 4,000 acres of land to grow it; and that 30,000 people, at least, would be employed in collecting it, at a season between hay-making and harvest, besides the persons required during the cultivation of the crop!

The present wholesale price of opium is 30*s.* per lb. and the import duty 9*s.* The usual quantity produced on an acre is 15 lb.; so that the Irish farmer can grow this crop at a premium of £8. 17*s.* 6*d.* sterling per acre. The exportation of opium is also carried on to a large amount; it

* See vol. VII. page 146 of the *Technical Repository*.

forms the medium of traffic in the South Sea Islands, where it is used as tobacco is in Europe; and it is probable, that if even a larger quantity was produced than is imported, it would find a ready sale.

Similar advantages would also flow from the cultivation of the *phormium tenax*, or New Zealand flax plant, which the author found growing most luxuriantly in Ireland. Some samples of flax, prepared from this extraordinary vegetable, were sent to England; and were found to be of a very superior quality.

Also, madder, liquorice, and rock-moss; thyme, lavender, rosemary, peppermint; the four latter for the extraction of their essential oils; lucerne, clover, canary, flax, for their seeds; and *an extensive list of other articles*, to the amount of *several millions sterling*, (for which we are now beholden to the wise economy of other nations), might also be raised in Ireland, to an extent that would employ the land now out of cultivation; and, at the same time, give effective employment to the farmers, their wives and children.

XLIII.—*On relieving the Head-ache.* *By Mr.* THOMAS ALLSOP.

SIR, *Madras, March* 20, 1825.

IF the following recipes, for relieving troublesome periodical head-aches, and other disorders of that nature, be not considered irrelevant to the plan of your valuable *Repository*, and you are pleased to allow them a place therein, they may be the means of rescuing many sufferers, like myself, from future attacks of those painful maladies.

I had been subject to frequent severe and distressing attacks of head-ache, giddiness, &c., and the relief I experienced from the advice of the profession, was but temporary; the pains returning again, after a few days, as usual.

The following *compositions* are entirely my own, and

they have happily, and I trust permanently relieved me, as I have had no returning symptoms of my disorder for the last eighteen months.

R.—Take comp. sp. lavender, 1 ounce,
Sp. sal. vol. (or *eau de luce*) 3 drachms,
Comp. tinct. benzoine, 5 ditto,
Vit. ether, 1 ditto,
Ol. nutmeg (or cinnamon), 1 scruple.

Mix, and put it into a 3oz. stoppered bottle for use, as follows:—Dip a small piece of sponge into the mixture, and apply it to the temples and forehead; and, if the pain be *very severe*, it may be also applied to the top of the head, back of the neck, &c. Let the party also smell to the moistened sponge, and, if means be taken to excite sneezing, as by tickling the nostrils with a feather, &c. the removal of the pain will be accomplished the sooner.

For a slight head-ache.—If a small quantity of nutmeg be rubbed down, or grated on a rough tile, &c. with spirits of wine, and afterwards a few drops of ether be added, and applied instantly, as above directed, it will fully answer.

I am aware that I shall receive neither thanks nor commendation from many of those who are, fortunately, strangers to these annoying complaints, and that my recipes may be deemed *nostrums* by them; but, such as they are, I affirm, that they have relieved me from my late sufferings, and may, perhaps, be considered worth the *trial*, at least, of those who are now the victims of these troublesome and painful disorders, to whom I would beg to recommend them.

Being outward applications, no danger can possibly be apprehended from a trial of them, even should they fail of success.

I am, sir, your obedient humble servant,

To T. Gill, *Esq.* THOMAS ALLSOP.

THE

TECHNICAL REPOSITORY.

XLV.—*Specification of the Patent granted to* EDWARD CHARLES HOWARD, *of Westbourn Green, in the County of Middlesex, Esquire; for Improvements in the Processes described in the Patent granted to him the 31st of October*, 1812 *; *for a Process for Preparing and Refining Sugar, and certain Apparatus for carrying the same into effect.* Dated November 20, 1813.

I THE said Edward Charles Howard, in compliance with the last-mentioned proviso, do hereby declare that the nature of my said last-mentioned invention, and the manner of performing the same, are particularly described as follows; that is to say: Firstly, instead of proceeding to refine the net or good sugar obtained by the first part of my process in the said specification, or any other sugar by solution with water, and the subsequent application of my finings, as is therein directed to be performed, I do in preference, and as one of my said improvements, proceed to refine the same by the action of steam and finings, which I find can be conveniently performed by placing the said sugar, with the due proportion of my finings intermixed therewith, in any suitable vessel, having within a perforated stage to support the sugar, and a ramification of steam pipes underneath the stage, from which steam is allowed to issue through small holes, by means whereof the sugar is heated and dissolved by the action of steam, as employed in many well-known chemical and manufacturing processes. And when the whole of the sugar becomes

* See page 129 of our present number.

fully dissolved, and has acquired the heat of about two hundred degrees, according to the scale of Fahrenheit, I proceed in the refinement either by filtration or by precipitation; and, in the event of my proceeding by filtration, I allow the solution to pass (by pressure of a super-incumbent column of the fluid, or of some other well-known force) through a filtre; and the filtre I commonly use is composed of an extensive surface of linen cloth, called Russia duck; in which filtre it is desirable that the temperature, so acquired as aforesaid, should be kept up, or as much as possible retained. But if, instead of proceeding by filtration, I proceed in the operation of clarification by repose or precipitation, (as directed in the said specification,) and if the solution should be stronger than is suitable to this operation, that is to say, if it should be considerably more than one-fifth heavier than an equal bulk of water, then I do dilute it with water until it is only one-fifth, or thereabouts, heavier than an equal bulk of water. But I do hereby declare, that the invention for which this patent is obtained by me, in so far as regards this first improvement upon my said former invention, does consist in the application of steam to the sugar at the same time that it is exposed to the action of the finings, and in thereafter causing the impurities to separate by filtration or by repose.

And, secondly, I do declare that it is advantageous, and is one of my said improvements, that the finings first mentioned in my said specification, if intended to be used with filtration, should be prepared by a due saturation of the alum and lime, without leaving any change of colour on the turmeric test-paper, as therein directed, or that the change which it may be convenient to produce in arriving at the point of saturation, by too great a proportion of the lime curds, should be removed by the subsequent addition of alum, not more than sufficient to leave the colour of the said test-paper unchanged when immersed therein. And that I find it also adviseable to add about three ounces of whiting to my said finings for every two and a half pounds

of alum employed in making the same. And that the finings, when thus prepared, will, in the operation with filtering, answer the purpose of those directed in my said specification to be used for the superior degrees of refinement in sugars; and that in case the said filtration be not used, it will be preferable that the alum should be dissolved in a larger quantity of water, namely, in about twenty-four instead of sixteen times its weight; and also in preference, that the lime-curds should be diffused in so much water as that each gallon of the mixture should contain about six hundred grains of the lime. And I do further declare, that the finings therewith made, and which can produce no change on the said test-paper, will in the operation, without filtering, form an excellent substitute for the finings directed in my said specification to be used for the superior degrees of refinement. And further, that in performing the operation without filtering, it is for the most part advantageous, and one of the said improvements, that two parcels of finings, each of the same quantity, in proportion to that of the sugar, as was directed in my former specification, should be used: that the first thereof should be employed with steam, as aforesaid, and allowed to separate in part only by precipitation, and that the dregs, dirt, and thickest of the liquor, should be thrown on any common filtre, instead of the dirt and insoluble impurities alone being separated, as directed in my said specification; and that the second parcel of such finings should be then diffused in the liquor so obtained by help of the first parcel, in or by the same manner of proceeding as if the dirt and insoluble impurities had by themselves been separated, as was in my said specification in that case directed to be performed. Which said second parcel of finings may well be employed in the next succeeding operation as a first parcel, either after their separation by a filtre or otherwise, or by pouring them as retained in the purified liquor in thick suspension upon the sugar, supported by the stage hereinbefore directed; but in the pre-

paration of double loaf from sugars previously refined, clarified, and evaporated, I find one parcel with the action of steam sufficient; and even that one parcel afterwards capable of acting with steam upon inferior sugars as a first parcel. But I hereby declare that my invention, for which this present patent is obtained, in so far as regards this second improvement upon my former process, does consist in the application of the finings, completely neutralised, when the process of filtration is to be employed: and that when filtration is not employed, it does consist in exposing the unrefined sugar successively to the action of two parcels of finings, the first whereof, in conjunction with steam, as hereinbefore described, removes part of the impurities chiefly by chemical agency; and the second parcel whereof, by mere diffusion, without steam, removes the residue of the impurities chiefly by mechanical agency, and is capable of being afterwards used as a first parcel in repeating this double process upon another quantity of sugar.

And, thirdly, I do declare that, as one of my said improvements, instead of evaporating, as in my said specification, any saccharine solutions and syrups or liquid sugar, I do evaporate the same in a close vessel, heated by any means, but by preference with steam, and do make and keep up a vacuum, more or less perfect, in the said vessel, but by preference so perfect at the commencement of working as to support not more than one inch of mercury; and of the various means by which this may be effected, I do prefer and employ a pump, with a condenser for steam by injection, as used in the steam-engine. And I further declare it to be highly advantageous, that the pump be kept in constant work, in order to effect the most rapid evaporation, although it may be found that the vacuum may continue, as shown by the guage, equally perfect, or very nearly so, during any intervals in which the working of the pump may be discontinued.

[*To be continued.*]

XLVI.—*Specification of the Patent granted to* AARON JENNINS *and* JOHN BETTERIDGE *both of Birmingham, in the county of Warwick, manufacturers and japanners in ordinary to his Majesty; for certain improvements in the method or methods of preparing and working Pearl-shell into various forms and devices, for the purpose of applying it to ornamental uses in the manufacture of Japan ware, and of other wares and articles, to which the same can be applied.* Patent dated March 29, 1825.

WE the said Aaron Jennins and John Betteridge, do hereby declare, that the nature of our said invention, and the manner in which the same is to be performed, are particularly described and ascertained as follows, (that is to say) our said improvements in the method or methods of preparing and working of pearl-shell into various forms and devices, are, first, by reducing the shell by filing, grinding, rubbing, or other proper methods, into flat plates of about the fortieth part, or in some cases the one hundredeth part of an inch in thickness. We then draw or pencil upon them with a hair pencil, the forms, shapes, or devices we wish to give the pieces of Pearl, either in a solution of asphaltum, made in the essential oil or spirit of turpentine; resin dissolved in the same menstruum, wax, varnish, or any fit and proper material, which is calculated to prevent the action of acids upon those parts of the pearl-shell so defended. When the coating thus laid on is dry, we then brush over it repeatedly, strong nitrous, or other proper acids, until, by corrosion, the forms so drawn or etched, are left free. We then clear off or remove the asphaltum, resin, or other defence by means of spirit of turpentine or other proper solvent, and the ornaments, sprigs, devices, or other figures are then fit for use.

We can, if necessary, coat or cover the whole surface or surfaces of the pearl-shell with an etching ground, or

other proper defensive varnish, or material, which will withstand the corrosive action of acids. We then draw, or trace with etching-needles, the forms or outlines of the devices through the said etching-ground, or other defensive varnish. Having thus drawn or etched the forms of any ornaments, sprigs, devices or figures upon the pearl-shell, we then brush over it repeatedly, strong nitrous or other proper acids, as above described. We can also, if required, pencil or draw with the asphaltum, or other proper defensive varnish, the forms or outlines of any parts of the surfaces of the thicker ornaments so freed, which we wish to relieve or leave prominent above the other parts of their surfaces; and we then brush over them the nitrous or other proper acids, until the intended effect is produced.

After having reduced the pearl-shell into plates of about the eightieth, or the one hundredth part of an inch in thickness, in the manner above described, we draw the outlines of any figures or ornaments upon them, and place them upon any flat and smooth hard surface, as iron-tinned plate, slate, marble, &c. We then, with a penknife, or proper cutting tools made on purpose, or sharp-pointed instruments, cut them out of the pearl-shell for use.

Lastly, when we wish to produce a number of figures, ornaments, or devices, all of an uniform shape and size, we take from six to twelve of the plates of pearl-shell, of about the eightieth or the one hundredth part of an inch in thickness, and we unite or combine them closely together by means of glue, gum, or other cement, into one mass; when dry and firm, we draw the outlines of the figures, ornaments, or devices upon one of the outer pieces, and holding the mass in a vice, or by other proper means, we, by the aid of files, drills, saws, or other proper tools or instruments, shape the mass into the required form; this done, by means of water, turpentine, alcohol, or other proper solvent, we dissolve the glue, gum, or cement, and the pieces become separated and fit for use.

Observations by the EDITOR.

By thus substituting *the free use of the artist's pencil* for the files, saws, and other tools, ordinarily employed in shaping this *brittle material* into form, *a degree of freedom and elegance is introduced into the pearl ornamental designs produced thereby*, of which we have never before seen any examples, the produce of this country; and we have no doubt that the employment of pearl in this way, will be very extensive in the arts.

XLVII.—*Farther particulars on half-round Boring Bits.*

IN our second volume, page 125, in an article "*On Instruments for Drilling and Boring*," we gave an account of the half-round cannon boring bit, from *Rinman*, the celebrated Swedish engineer's extensive work on the machines used there; and in page 127, we gave some particulars of the half-round boring bits used here. We now add some farther particulars on these highly useful instruments.

Mr. Peter Keir, (whose excellent screw-stocks and dies we have described, in our former and present numbers,) informs us, that these bits, like turning tools, ought to have the angles of their edges varied, according to the nature of the metal to be bored; thus, wrought iron would require a very different angle from that used for *cast-iron*: that if in use, the bit trembles or jars, it is a sign that the angle is too acute, and it must be made more obtuse, or nearer to a right angle with the plane, or flat face of the bit. Again, if the obliquity of the other, or crossing angle, be too great, the bit will also have too great a tendency to form a nipple or cone, in the centre of the bottom of the hole, and to bore the hole gradually wider and wider, instead of truly cylindrical, as it will do when properly formed; and that fault must therefore be corrected by grinding the bit so as to reduce its obliquity, or bring it nearer to a right angle with the sides of the bit.

In plate VIII. fig. 1, shows one of these bits in use; fig. 2, an end view of it, and fig. 3 a top view of it. *a* the bit; *b* a section of the body to be bored, which must be held firmly in a lathe and carried round by it. A conical hole must be turned in the centre of the end of the body, previous to entering the bit, and a little wider than the latter; the bit will then readily find its way. The bit has a central hole at its opposite end, and is supported thereby upon the conical end of the lathe-screw *c*, which must be gradually turned to urge it forward, the bit being at the same time, held from turning round at *d*, either between the chaps of a hand-vice, or in some other secure way. In this manner, and with the precautions before indicated, the bit will proceed in making *a perfectly straight and cylindrical hole*, even although the metal to be bored should be a little unsound from air-bubbles, formed in the casting of it, &c. The length of the semi-cylindrical part of the bit is generally twice or three times its diameter; and this, Mr. Keir thinks is sufficient to preserve its rectilinear direction in the bore. The stem or shank, beyond the semi-cylindrical part is so formed as to be strong enough not to bend, and yet is entirely removed out of the way of the bore; and does not, as in the Swedish bit, touch the upper part of it in two places. Our figures are drawn from a bit kindly lent us by Mr. Keir for that purpose; and their accuracy may therefore be relied upon.

Mr. Jacob Perkins forms his half-round bit of a solid steel cylinder, from near the end of which he removes a portion of one half its substance, and shapes its end to the proper angles for cutting, as we have above described, and as shown in fig. 4, (in which figure, the dotted lines show the original form of the cylinder;) and in figs. 5 and 6. He states that when the solid part of the cylinder enters the bore, nothing can disturb the bit from pursuing its directly linear course.

For widening holes already drilled, cast, or otherwise formed, Mr. John Evans, an ingenious mechanic, of War-

dour-street, Soho, thinks he has improved upon the bit, by giving to it a slight excess of the semi-circle, say, perhaps, a thirty-second part of a circle, as shown in fig. 7; and which he also forms into a cutting-edge, by hollowing it at its back, and as shown in fig. 8.

Some eminent mechanics also line the backs of their half-round boring bits with rounded pieces of wood, either let into a dovetailed groove, and secured therein by screws, as shewn in fig. 9; or merely placed in contact with the flattened back of the bit, and held fast by screws, as seen in fig. 10; in this latter case, a considerable saving of iron and steel is made in the larger bits; and the cutting part may be better *condensed* by hammering it, previous to hardening and tempering it, than can be done in a thicker mass. This practice, however, requires the frequent renewal of the pieces of wood as they wear away in use; and, as it is necessary that they should be turned into portions of cylinders in their places upon the bits, so it becomes also necessary, that a central hole should be provided in the end of the bit, for the cone at the end of the lathe-screw to enter, and support it in the lathe, whilst turning the wood into shape. We have, however, in the beginning of this article, dwelt on the necessity of accommodating the angles of the cutting edges, to the nature of the bodies to be bored, and this can only be done by repeatedly grinding away the end of the bit accordingly. Now, we have found in several workmen's hands the original central hole remaining, upon which the bit was first formed; a little steel being left around it, as shown in figs. 11 and 12, to contain it; but in others that it had been nearly if not quite obliterated, by repeatedly grinding away the end of the bit. In order to prevent this latter evil, Mr. Ward, a judicious workman and mechanic in the Borough, contrived to drive or *upset* an elevation of steel considerably within the substance of the bit from its end, to receive the central hole, as shown in figs. 13, 14, and 15, by means of a round punch with a flat end to it, being held against the

centre of the intended bit whilst red-hot, and the head of it repeatedly struck by an assistant, until a short longitudinal semi-cylindrical groove had been formed in the middle of the flat face of the bit; and the steel so displaced, had formed a bulge or rising, high enough to admit of the central hole being afterwards formed in the substance of it; and thus the end of the bit could repeatedly be ground away, whilst the central hole still remained perfect. It has been suggested to us, that a central hole might also be formed in a block of steel, screwed into the flat face of the bit, as shown in fig. 16; and in that case, a conical groove may be filed in the face of the bit, to permit the conical point of the lathe-screw to enter it as shown.

Having thus dwelt at some length on the half-round boring-bits, as applied to forming or widening *cylindrical* holes, we shall next proceed to show some other applications of these valuable instruments to the forming holes of other shapes.

Fig. 17 is a front view, and fig. 18 a side view, of a half-round bit adapted to make holes which had been previously drilled and made taper, of a proper shape to receive screws, similar to that shown in fig. 19: it will be seen in fig. 17 that the lower end of the bit has been lessened in its diameter, sufficiently to allow the bottom of the hole bored by it to be tapped with a female screw to fit the screw.

Fig. 20 is a side view; fig. 21 a bird's-eye view; and fig. 22 an end view of a half-round bit made by Mr. Perkins, for making conical holes: this, like his cylindrical bit above described, is made of a solid cylinder of steel, having a hole drilled in its centre, ending in a hollow cone; and, after being turned conical on its outside, had its substance filed away one-half, its end formed into the proper cutting angles, and hardened and tempered. This bit will allow of being repeatedly renewed, by softening it, and turning it into shape as required.

Fig. 23 is a half-round conical bit, made by filing a gap

in the cone, and leaving the cylindrical parts of it entire. This bit was made by Mr. Keir for boring the valve-seats of the injecting pumps, in Bramah's hydraulic presses, and which important purpose it answered most completely. At *e e* a flat cylindrical ring is left, which prevents the bit from penetrating too deep.

[*To be continued.*]

XLVIII.—*Proceedings in the Franklin Institute, at Philadelphia, U. S., on a charge made against Mr. Peter A. Browne's claim to the originality of a certain invention, relating to an improvement in Pistons, for which he obtained a Patent in the United States.*

Franklin Institute.—THE committee appointed on the 5th of May last, to investigate the charge made against Mr. Peter A. Browne's claim to the originality of a certain invention relating to an improvement in pistons, for which he obtained a patent from the UnitedStates,

Report.—That they have devoted to this subject all the time and attention which, from its importance and delicacy, it required, and that the result of their enquiries has been as follows:—

The charge of which Mr. Browne complains, was originally preferred in *Gill's Technical Repository*, vol. IV. page 204, published in London, in September, 1823. It is thus worded, " Mr. Barton now represents to us other hardships to which he has been subjected, with respect to his patent metallic pistons; and particularly that in the the United States of America, where they are extensively used, *they are not even known as his invention*, but as that of a Mr. Peter A. Browne, an American advocate, who came over to this country several years since, and presuaded Mr. Barton to allow him to take out a patent there for their joint benefit: *but from which the latter has never yet enjoyed any advantage whatever.*" This charge has since been circulated in some Americun publications, but without any other document in support of it than the mere assertion of the Editor of the *Repository*.

In answer to the charge, Mr. Browne has submitted to your committee sundry documents, viz.:

1st, The original letters patent granted to him by the president of the United States, dated October 9th, 1816.

2d, The original contract or agreement entered into between himself and John Barton, of the city of London, which agreement was executed in London, in July, 1816.

3d, An original letter, written to Mr. Browne by Mr. Barton, bearing date July 6th, 1821, and introducing to Mr. Browne, as Mr. Barton's particular friend and special agent, Mr. Richard Holden, who is at present in this city.

4th, The copy of a letter, written by Mr. Holden to Mr. Thomas Gill, Editor of the *Technical Repository*, bearing dated November 26th, 1823. This copy was taken from the original letter, by Mr. Wm. F. Dean, of this city, whose certificate of the truth of the copy was sworn to by Mr. Dean, before Joseph B. M'Kean, esquire, president judge of the district court for the city and county of Philadelphia.

5th, The original certificate, signed by James Page, esquire, a gentleman well known to your committee.

6th, The original certificate, signed by Mr. Patrick Galbraith, likewise well known in this city.

From the attentive perusal of these documents, as well as from verbal and written communications from Mr. Holden and Mr. Page, it appears to your committee to rest upon undeniable evidence, that Mr. Browne's invention essentially differs from Mr. Barton's, though both tend to produce the same effect. This fact is proved by the terms of the agreement, to which Mr. Barton was a party, in which it is distinctly stated, that "whereas the said Peter A. Browne hath invented an improvement in pistons and steam-engine machinery, for which he agrees, as soon as practicable, after his return to the United States, to apply for a patent; and whereas the said John Barton hath also invented an improvement in pistons and steam-engine machinery, *which may be applied to similar purposes*, and which, if patented and used in the United States, would

interfere with the said Peter A. Browne's, now in consideration, &c.:" and, further, it is stipulated in the same agreement, that " the said Peter binds himself not to disclose *either of the said inventions in Europe.*"

This fact also appears to your committee clearly established, by a comparison of Mr. Barton's invention, as described in the 4th volume of the *Technical Repository*, with Mr. Browne's, as explained in the schedule annexed to, and making a part of his patent.

From the testimony of Mr. Page and Mr. Galbraith, it further appears to your committee, that Mr. Browne's invention was made prior to his visiting England, and, therefore, before he had become acquainted with Mr. Barton: and also, that, as Mr. Page has stated to your committee, a model of Mr. Browne's invention had been made under his directions, by a mechanic of this city, previous to Mr. Browne's sailing for Europe, which model he took with him to England, intending, as he then informed Mr. Page, to take out a patent for it in that country.

Most of these facts were known to Mr. Barton's friend and agent, Mr. Holden, who, after adverting to them in his letter to Mr. Gill*, adds, " from all the conversations between me and Mr. Barton upon the subject, I considered the above statement corroborated."

In the same letter Mr. Holden says, " I do positively declare, that I am not acquainted with an instance in which the piston above alluded to has been introduced in this country, nor do I believe that it has occurred." In his communications to your committee, he has repeatedly asserted that he had never heard of the metallic piston being used in America, and that wherever he has mentioned it, " it has been rejected on account of the accuracy required in the workmanship, and as being too expensive."

From a review of these facts your committee do not hesitate in declaring, that not the least foundation exists for the terms made use of by the respectable editor of the

* We know nothing of this letter.

Repository, when he states that he "cannot sufficiently regret that any one should thus have deprived the inventor not only of all profit from his discovery, but also have laid a claim to the invention itself."

In Mr. Dean's affidavit, it is stated, that he thinks that "he put the original letter, written by Mr. Holden to Mr. Gill, in the letter bag, left at the merchants' coffee-house, for England."

Your committee have searched the files of the *Repository* down to the April number of the present year, inclusively, it being the latest number to which they have had access. They regret to add, that they have found in it no notice of Mr. Holden's letter, nor any correction of the mistake into which Mr. Gill had been led. From the high opinion which they have at all times been induced to form of Mr. Gill's candour and impartiality, they suppose that the letter must have miscarried.

Your committee did not think it their duty to inquire into the merits of Mr. Browne's invention in a practical point of view, still they cannot refrain from observing, that Mr. Barton's invention is extensively used, and appears to have received very favourable certificates from Messrs. Perkins, Bramah, Howard, and many others in England; and that it has been used with great advantage in iron-works, in the mines of Cornwall, in oil-mills, in steam-packets, in distilleries, in gas-works, &c. Finally, that wherever a piston is required to work in a cylinder, whether for a steam-engine, or otherwise, that it is productive of great benefits. Your committee are not aware that Mr. Browne's invention is in any manner inferior in importance to Mr. Barton's; and, therefore, regret that it should not, as yet, have received the attention of our engineers, for they are inclined to believe, with Mr. Holden, "that were the piston patented by Mr. Browne, introduced into practice in America, it would prve of national importance."

The committee conclude by offering the following resolutions:—

Resolved, That the board of managers of the Franklin Institute are perfectly satisfied that the publications tending to detract from the merit of Peter A. Browne's claim to an invention, or improvement in pistons, are entirely unsupported by evidence, and that they are in direct opposition to the best testimony which the board of managers have been able to obtain on this subject.

Resolved, That previous to returning to Mr. Browne the original documents submitted by him, the secretary of this board be directed to copy the same at large, in the minute-book of the board, with the exception of the letters patent.

Resolved, That the committee of publication be directed to publish the report, in such manner as they shall deem best.

All which is respectfully submitted by

JAMES RONALDSON,
WM. H. KEATING,
SAMUEL R. WOOD. } Committee.

Philadelphia, June 7th, 1825.

This report was read and adopted, and the resolutions annexed thereto are unanimously passed.

Philadelphia, 8th Mo. 20th, 1825.

Respected Friend, THOS. GILL,

I herewith transmit to thee a copy of a report, made by a committee of the Franklin Institute. As the charge against Peter A. Browne first appeared in in thy journal, we think it due, as well to Peter A. Browne as to thyself, to communicate this to thee, and doubt not but thou wilt be quite disposed to do *him* justice. If copies of the documents referred to are desired by thee, I will cheerfully transmit them to thee.

Should we be able to promote the value of thy useful work, by any thing among the files of the Institute, it will afford us a pleasure to do so.

I remain, with respect, thy friend,

SAMUEL R. WOOD.

We have given insertion to the above documents, knowing the great respectability of Mr. Wood, one of the committee, and from whom we have received them. At the same time we must own, that, in the absence of all knowledge as to Mr. Browne's invention, which he states to have realized previous to his leaving the United States for England, we are utterly unable to judge of the merits of it: of Mr. Barton's we can speak from our own experience, and if Mr. Browne will favour us with the particulars of his invention, we shall then be better able to decide between their respective merits. At present, we see no cause to alter our opinion on the hard treatment Mr. Barton has met with.

We have taken care to apprise Mr. Barton of these attempts on the part of Mr. Browne to re-establish himself in the opinions of his fellow-citizens, in consequence of our publishing the claim of Mr. Barton to the invention of the *metallic piston and substitute for a stuffing-box, and which we consider as amongst the most ingenious and refined examples of mechanical skill!* Mr. Barton is now in Cornwall, applying one of his pistons to a steam-engine for raising water from a mine; but we have no doubt that he will be able to furnish us with a satisfactory communication on the present subject, in time for our next month's number.

Meantime, we do not see that our statement, founded upon information furnished by Mr. Barton, is in any material degree affected by these proceedings. It appears, indeed, that no benefit has been derived from the sale of these metallic pistons in the United States; but this is so much the worse for Mr. Barton, who naturally expected to have profited from the arrangement he had made with Mr. Browne.

We are glad that our endeavours to do Mr. Barton justice have been duly appreciated in the United States; and also to find that the *Technical Repository* is held in such high reputation there. We should, indeed, willingly avail ourselves of the very friendly offer of Mr. Wood, to fur-

nish us with any subjects on the files of the *Philadelphia Franklin Institute*, for publication in our work, did we but know the contents of those subjects. No doubt there must be many excellent articles therein, and we shall request a friend of ours, who is shortly proceeding to the United States, to examine the files.

We cannot omit in this place to express our gratitude to those many liberal friends of science and the useful arts, who have continually enabled us to benefit the public, by freely permitting us to communicate the results of their experience and ingenuity, as in this progressive state of improvement such knowledge is of the utmost importance; and, indeed, it is only from the general diffusion of such information, that any great discoveries can now be expected to originate.

The following testimonies of approbation of our work are extracted from a letter which the Editor has lately received from that scientific and patriotic gentleman, Dr. George Birkbeck:—

"DEAR SIR,

"My best thanks are due to you for the copy which you have had the kindness to forward to me, of *your very useful periodical*, as well as for your very liberal offers of assistance in the large and important national work which I am about to undertake. This publication, I hope, will be productive of much mechanical good.

"*My opinion is that, by diffusing still more widely a taste for mechanics, I shall extend the demand for your publication*, which, as it records the passing novelties and projects, will be equally necessary when the record of the state, the actual and permanent state of British arts and manufactures which I am to publish, may be in the hands of the scientific enquirer."

This approbation from a gentleman so eminently qualified to estimate his labours, cannot but serve as a stimulus to the Editor, to render his work still more deserving of the public patronage.

XLIX.—*On proving the strength of Leaden Pipes.*

SOME curious and interesting experiments on this point have recently been made in Edinburgh, by Mr. Jardine, at the Water Company's yard, in Heriot's-green, with the view of determining accurately the proper strength, or thickness of metal, to be given to the pipes intended for conveying water through different parts of that city. This is an important subject, and one regarding which practical men have, hitherto, been much in the dark. The experiments, therefore, set on foot by this distinguished engineer, cannot fail to be of great utility, and we hope the particulars of them will be communicated to the public; for it happens in this, as well as in many other branches of mechanics, that a few judicious and careful experiments, in one or two particular instances, are sufficient to comprehend a vast variety of cases which are continually occurring in practice. The strength of pipes, for example, even those of the same thickness of metal, varies greatly with the calibre of each. The pipe, in fact, becomes weaker exactly as its calibre, or internal diameter is enlarged.—Hence, it is quite unnecessary to make trials of all the different sizes of pipes; as one good observation of any particular diameter and thickness of metal, affords a rule for computing the comparative strengths of pipes of any other dimensions whatever.—The following are the results of two of the above experiments.

The manner of making the trial is this. The pipe to be tried is closed at one extremity, while the other communicates with a forcing-pump, by means of which water is thrown into it, and forced till it presses the pipe, on all sides, with a violent pressure, in the same manner as if the pipe were conveying the water of a lofty spring, the effect of which is to press out the pipe on all sides, in proportion to the height of the fountain-head. But the pump is also furnished with a valve or gauge, which measures exactly

the degree of pressure communicated to the pipe; so that, in every experiment, we can compute the height of the reservoir which would have caused a similar pressure by the water conveyed from it; and in this manner obtain a rule for adapting the strength of each pipe to the pressure which its situation subjects it to. When the water from the injecting pump first begins to press out the pipe, little or no alteration is observed on it for some time. As the operation of forcing proceeds, however, and the pressure thereby becomes increased; the pipe gradually swells throughout its whole length, until, at last, a small protuberance is observed, rising in some weak part, which continues increasing, until the substance of the metal, becoming thinner and thinner, is at last fairly rent asunder; when the pipe bursts with a crash, and the water issues with great violence.

In the first experiment the pipe was of one and a half inch bore, and the metal, which was remarkably soft and ductile, was one-fifth of an inch in thickness. This was forced, as above described, until the pressure became equivalent to that of a spring, or column of water 1000 feet high, which is equal to thirty atmospheres, or 420lb. on every square inch of pipe. This it sustained without alteration; but, with a pressure equal to 1200 feet, it began to swell, and with 1400 feet, or 600lb. on the inch, it burst.

It appears surprising that the soft material, lead, should sustain so enormous a pressure; but this arises from its being equally distributed through every part of the mass. There is no cross-strain, or unequal action, in different parts of the pipe, but a fair stretch throughout the whole surface of it; which, it is well known, is by far the most favourable situation for strength.

On measuring the above pipe after the experiment, it was found to have swelled out from one and a half inch in diameter, to one inch and three-quarters; so that a part of the original pipe, which had not been subjected to any

pressure, could be inserted within the fractured piece. The fracture of this piece presented a very striking appearance. The edges were no way ragged, but quite smooth and sharp, like a knife; showing how the metal had been gradually distended and thinned out to nothing, by the internal pressure, as if the pipe had consisted of soft clay, or wax.

In the second experiment the pipe was two inches in diameter, and one-fifth of an inch thickness in metal; this sustained a pressure of a column 800 feet in height, with hardly any swelling; but with 1000 feet, it burst. The fracture here was not so fine as in the other, the metal being much less ductile.

Such is the extreme pressure which these pipes will bear before bursting! But it would be unsafe in practice to subject them to more than one-third of this. Still, however, it appears that a two-inch pipe, with one-fifth of an inch thickness of metal, will be sufficient for withstanding a pressure of 800 feet. Many other examples might be given of the application of these experiments, did our limits permit. We shall just mention, however, an interesting piece of antiquity, which was lately brought from Italy, by Professor Leslie: it is a Roman lead pipe, supposed to have been used in conveying water to the baths of one of the emperors; it is not truly round, but of an irregular oval, or flattened shape, the metal appearing to have been turned over longitudinally, without any roller or mandrel within it, and then strongly soldered. It is, as near as we can recollect, about two and a half inches diameter one way, and two inches the other; and the metal about three-fourths of an inch thick. Now, it is evident, from the above experiments, that the strength of this pipe, is enormously above what the occasion could require: and this shows the advantage of having accurate experiments made to direct the construction of such works.—From the *Caledonian Mercury.*

This method of proving the strength of lead pipes, was,

we believe, first described by Dr. Desaguliers, and is said to have suggesed the original idea of that invaluable power, the Bramah's hydrostatic press.

L.—*On the comparative Advantages of different Water-Wheels, erected in the United States of America, by* JACOB PERKINS, *Esq.; and in this Country, by Mr.* GEORGE MANWARING, *Engineer.*

MR. PERKINS erected at Newbury Port, a water-wheel of thirty feet in diameter, on the plan of, what is termed in America, a *pitch-back;* but, in this country, a *back-shut;* that is to say, it receives the water near to its top, but not upon it, as in *overshot-wheels,* and is, indeed, the most judicious mode of laying water upon the wheel; as, in case of floods, the wheel moves in the same direction with the water, and not in the opposite one; neither is the wheel encumbered, as in the *overshot* wheel, with an useless load of water at its top, where it does nothing but add to the weight upon the necks or pivots of the wheel-shaft, and to the consequent loss of power by the increased friction upon them; whereas, in the *pitch-back* or *back-shut wheel,* the water is laid on at a point, where it acts by its leverage in impelling the wheel, and has yet time to become settled in the buckets, previous to its reaching the point level with the axis, and where it acts with its greatest power. The wheel itself was constructed of oak, but with iron buckets; and it had a ring of teeth around it, which drove a cast iron pinion, of three feet in diameter, which gave motion to three lying shafts, each of thirty feet in length, coupled together, so as to form a line of ninety feet; and from which, the necessary movements were communicated to machinery for making nails.

Mr. Perkins placed his pinion as close as possible under the pentrough, which delivered the water upon the wheel; and he thus, greatly lessened the weight

upon the necks or gudgeons of the wheel-shaft, by suspending it, as it were, upon the pinion; whereas, had he, as usual, placed it in a horizontal line with the axis of the wheel, and on the opposite side of it; he would have loaded the necks with a double weight; namely, the water on the one side of the wheel, and the resistance opposed by the machinery to be driven by it, on the other. He also took care that the teeth upon the wheel and the pinion should always *be kept wet, or run in water,* instead of being *greased,* as usual, and which he found sufficient to cause them to run smoothly and without the least noise. The motion of the wheel's periphery was about three feet per second, agreeably to the improved theory, so ably demonstrated by the late scientific Mr. Smeaton; and it continued to perform its work, with great satisfaction to its owners, for ten years, when it was unfortunately destroyed by fire.

An opportunity shortly presented itself of comparing the advantages of this water-wheel with another, which the proprietors were induced to erect, on the representations of a mill-wright, that the wheel was too high, and that it would be much better, were it only twenty-three feet in diameter, and received its water at the breast. The trial, however, proved that *the new wheel required twice the water to work it, which actuated the former one, and only did the same work!* the nail-machinery having escaped the fire which destroyed the water-wheel.

Mr. Manwaring has also had an opportunity of verifying the advantages of a similar construction to Mr. Perkins's, in this country; in a cast-iron *back-shut* water-wheel of the same diameter, as his, viz. thirty feet, and which also has a ring of teeth around it, driving a pinion of three feet in diameter, posited on the same side of the wheel as Mr. Perkins's, but not quite so high, it being a little above the centre of the wheel, and the teeth of the wheel and pinion are always kept wet.—

This wheel is employed in grinding flour, at a corn-mill in Sussex, and drives six pair of stones, besides the other necessary machinery, it moving at the rate of about three feet per second; and so great satisfaction has it given, that Mr. Manwaring is now constructing another water-wheel npon the same plan, and for the same proprietor; only, that it will be wider, and is calculated to drive eight pair of stones.

We are glad to have this opportunity of communicating these valuable practical facts, the same results being also obtained in two countries so widely separated as the United States and England, make them more valuable; and proves, that when persons think rightly, they will naturally think alike.

LI.—*On* Mr. Perkins's *Methods of Turning and Boring hard, chilled Cast Iron.*

Mr. Perkins (who, in the employment of high-pressure steam in his engines, has met with obstacles hitherto unexperienced, and has overcome them with a perseverance truly wonderful) lately shewed us a flat surface of *chilled cast iron, so hard that no file would make an impression upon it, and which had, nevertheless, been accurately turned in the lathe!*

It was one of the parts of his rotatory valve, which, when made of cast-iron as at first, the pressure of the steam upon it caused to rub so hard upon the other flat surface, that considerable friction and wear took place between them; and he was, therefore, compelled to substitute chilled cast-iron in place thereof; since when, their action has been productive of a beautiful polish upon each surface, and which polish is likely to continue, and even improve, in use.

Mr. Perkins informs us, that he accomplished this difficult task, by giving to the body, when turning it in the lathe, *an exceedingly slow motion, say, at the rate of*

only six feet per minute! The turning tool, which was made of steel, hardened and tempered as usual, was also carried across its face, with a very slow and steady movement.

What is yet more surprising, it is also Mr. Perkins's intention, *to bore his working cylinders after forming them of chilled cast-iron;* and we have great confidence, after seeing what he has already performed, that he will succeed in this still more difficult task.

He had, likewise, already turned a circular cavity in a hardened and tempered steel ring, and that after it had been so hardened and tempered, and had thereby avoided all risque of its changing its shape, from warping in the hardening, as is generally the case.

We had only known of *chilled cast-iron rolls* being *dressed,* as it is termed, in an engine, by means of flat metal laps, supplied with emery; *and had no idea, that chilled cast-iron could ever have been worked by turning or boring it!*

LII.—*On the Superiority of the Straw-Paper made by Mr.* LOUIS LAMBERT'S *new Patent Process, over that formerly made by Mr.* MATTHIAS KOOPS.

MR. KOOPS took out a patent for making paper from straw, upwards of twenty years since; the manufactory was first established at the Neckinger Mill, at Bermondsey; and afterwards removed to the Thames Bank, Chelsea, where it terminated unsuccessfully.

We cannot wonder at this failure, when we consider that his process consisted in merely steeping the straw, previously cut into pieces of about two inches long, in *cold* lime-water, and afterwards subjecting it to the *cutting* action of the paper mill; and the produce, after all, was a harsh, coloured paper; which never came into general use.

Mr. Lambert, on the contrary, merely frees his straw

from the knots, and then submits it to *ebullition* either with quicklime in water, or with caustic potash, soda, or ammonia, in order to extract the colouring matters and dispose it to become fibrous; he then washes it, and next exposes it to the action of a hydro-sulphuret, composed of quicklime and sulphur in solution, in proper proportions of the quicklime, sulphur, and water (as indicated in the specification of his patent, published in page 369, of our present volume) in order to free it from the mucilaginous and *silicious* matters, so prejudicial in paper making. He then washes it thoroughly in successive portions of water, by exposing it to the *beating* (not *cutting*) action of the paper mill, till all smell of the alkaline sulphuret is entirely removed; he then presses it, and afterwards submits it to the usual operations employed in bleaching vegetable fibres, viz. to the action of chlorine, either separate, or in combination with lime; or by exposure to the open air and light, upon the grass. It is, lastly, exposed to the action of the rag engines usually employed in paper making, in order to reduce it into paste or pulp, previous to being made into paper.

The produce of this superior process, is a *soft, white, pulp* fit for making *fine paper*, and very different indeed from the *harsh, coloured paper*, made under Mr. Koops' patent.

LIII.—*On French Paper, made of the Boom, or Cross-fibres, of Hemp and Flax.*

We have lately been favoured by a friend with specimens of coloured papers, made of the above materials, procured *in the improved French manufactures of hemp and flax, without water-retting or fermentation*, and which were of yellow and cream colours; they were rather tender, however, and seemed to require a mixture of longer fibres, to give them sufficient strength and durability.

This is making a much better use of the fibrous part of the boom, or refuse of flax and hemp, than merely converting it into manure, as is done in this country; and, when the improved methods of treating flax and hemp by machinery, instead of water-retting them, shall have become common in this country and Ireland, as we hope and trust they will in time do, such materials may be obtained in considerable quantities, and form a valuable addition to the paper maker's resources.

LIV.—*On a new French Process, for dressing Flax and Hemp by Machinery.*

SPECIMENS of French-dressed hemp, with parts of the stems remaining entire at the ends of the stalks, were lately laid before us; they were evidently dressed by means of *brakes*, and not by means of *grooved rollers*, as in the late Mr. Lee's improved method; and the secret was to be disposed of by way of a subscription, and when a certain number of persons had subscribed, each was to be furnished with a model of the machine, and an account of the method of using it.

The hemp was possessed of all its native strength, and is an additional proof of the anxiety of the French to adopt better means of treating hemp and flax than by the old "*water-retting*" system.

We have, in another article, mentioned a valuable use of the boom of hemp and flax for paper making.

LV.—*Queries on Propagating the White-Thorn, from Cuttings of its Roots. By a* CORRESPONDENT.

Rhyadar, South Wales,
Sept. 4, 1825.

SIR,

I HAVE met with a valuable communication in your Technical Repository, for this month, on the subject of propagating the white-thorn from cuttings of the roots. Unfortunately, the direction therein given, depend great-

ly for their clearnees and proper illustration, upon specimens or patterns of the size of the roots, their kind, and the mode of cutting, which specimens are accessible to few persons. So much, I am aware, depends upon minutiæ, in matters of this nature, that I am induced to beg from you some instruction, in order that I may give an immediate trial to a plan which promises such essential advantage to the agriculturist. The points upon which more particularly I beg for information, are the following:

1.—Of what size should the roots be, which are to be cut off for planting? (say the size of a quill at the top, or otherwise.)

2.—Are the roots, (or should they be) distinguished, by having buds, or embryo shoots upon them?

3.—Should the fibrous extremities of such roots be used, as well as the other parts?

Your replies to these questions, will very materially assist me.

I am, sir,
Your obedient servant,
W. G. C.

T. Gill, *Esq.*

Replies to the above Queries, by the Editor.

We are glad to have it in our power to afford our worthy correspondent, at least, some information on the points he mentions, derived from our personal knowledge of the late Mr. Taylor's practice, and from other sources of intelligence.

The first account we have met with of the successful practice of raising quickset hedges from cuttings of their roots, was in the fences along the line of the old Birmingham Canal, many years since, which were so formed; and, consequently, the invention did not originate with Mr. Taylor.

We thought, at the time when the Society of Arts published the account of this process, that it would have

been better, instead of referring the public to the specimens left with the society by Mr. Taylor, to have given a few more particulars concerning them, which would have rendered such reference unnecessary; and we shall, accordingly, now proceed to do so.

With regard to the size of the roots, the smaller are better than the larger ones, only they require to be kept two years in the nursery, before they are fit for use.—The smaller roots should also be cut into shorter pieces than the larger ones. Those of the thickness of a quill, may be four inches long, the thinner ones shorter. A friend of Mr. Taylor's, at Manchester, and who assisted him in his experiments, instead of making two cuts across the thick end of the root, so as to form a sort of obtuse wedge, and which was done, merely to distinguish the top from the bottom of it, in the planting, only made one cut slopewise at its top, as well as another at the bottom of it.

It does not appear, that it is necessary that the roots should have any buds, or embryo shoots upon them.

All the shoots but three should be removed, and those be cut off pretty close; and only a single row of thorns should be planted for a hedge, which will grow so bushy at the foot, that no animal can push through it.

The three year old specimens were about the thickness of a finger; when taken up, their stems were cut off about three inches above the place where the earth covered them, leaving, as above mentioned, from one to three shoots upon them; and, at the same time, their roots were shortened, so as to leave them about three inches long, when they were ready for use in forming the hedge.

LVI.—*On a Method of cultivating Cucumbers in a Peach-house. By* Joseph Brookhouse, *Esq. of Warwick.**

In this house the peach-trees are trained to the back

* From the London Horticultural Transactions, vol. v.

wall only, the lights being placed in the usual sloping direction, used for fruit houses. In the front, a dung pit is formed, extending the whole length of the house; one side is formed by the front wall, and the other by a brick-in-bed wall, on the inside of the house; the surface of the bed being level with the front wall-plate, which supports the sloping rafters and lights. The bed is formed in the usual way with dung, and covered with mould. At first, the plants are protected by hand-glasses, which give them the advantage of double glass, and make them strong; when they are long enough to train, they are attached to a wire trellis, which is placed about ten inches from the glass.

The plants are suffered to run, without stopping the leader, as is usually done; and when the side shoots break, they are almost certain to show fruit; these are immediately stopped at the fruiting joint; but if any of them do not show fruit at the first joint, they are cut entirely away. By this means, nothing but productive or fruit-bearing runners are left upon the plants; for their side-shoots will, almost invariably, produce fruit again, if stopped at a barren joint. When the fruit-bearing shoot is stopped where it shows fruit, Mr. Brookhouse always leaves a leaf at the base of the fruit; and when the fruit is cut, he takes off the leaf with it. By this method, he keeps the plant free from unnecessary leaves, and admits sun and air to the fruit. If the plants run too long, and interfere with the peach-trees, he unties them, strips off the lower leaves and side-shoots, to within four feet of the end shoot, and lays the bare part of the stem down upon the bed, covering a part of it with the mould; at the same time stopping the main runner at a fruiting joint, and training about four feet in length up the trellis-work. In consequence, the runners are so lowered as not to interfere with the peach-trees, and they break afresh, yielding fruit plentifully till September or October. All the fruits which

are produced hang pendant from the wires, and thus preserve their beauty and regularity of shape, and also are equally green all round, which is very essential to their good appearance. The bed, on which the cucumbers are grown, is renewed every year, but is never lined.

LVII.—*On a Hot-bed for forcing Cucumbers. By* CHARLES SCRACE DICKENS, *Esq. F. H. S.**

INSTEAD of forming a solid bed of dung, as is usually done, he constructs four piers, one foot and a half high, and nine inches square, to support a two-light frame. Two pieces of timber, four inches square, are laid from pier to pier at the back and front; on these is laid a platform of boards an inch and a half thick; these are plaistered with neat's dung, which, when dry, is covered two inches thick with good mould, and the frame is placed on the piers. Under the centre of each light, a bushel of mould is laid, forming a hillock. After this, the lights are put on, and linings of hot dung applied all round, the interior space remaining hollow. In two days the bed is fit for use: if the heat is found to decrease, a wheelbarrow-full of fresh dung is added, and shaken up with the linings, and well watered. In order to confine the heat, the whole of the linings are plaistered with neat's dung, by which means a temperature is obtained of from 75 to 80 degrees. A bed, which was thus made on the 3d of February produced on the 30th of March two fine cucumbers, measuring thirteen inches in length.

LIST OF PATENTS FOR NEW INVENTIONS,

Which have passed the Great Seal since Aug. 23, 1825.

To George Henry Lyne, of John Street, Blackfriars Road, machinist and engineer, and Thomas Stainford,

* From the same work.

of the Grove, Great Guildford Street, Southwark, smith and engineer; for certain improvements in machinery for making Bricks. Dated August 23, 1825.—To be specified in six months.

To William Parr, of Union Place, City Road, in the county of Middlesex, gentleman; for an improvement or improvements in the mode of propelling Vessels. Dated August 27, 1825.—In six months.

To John Bowler, of Nelson Square, Blackfriars Road, in the county of Surrey; and Thomas Galen, of the Strand, in the county of Middlesex, hat manufacturers; for certain improvements in the construction or manufacture of Hats. Dated August 27, 1825.—In six months.

To Charles Mercy, of Edward's Buildings, Stoke Newington, in the county of Middlesex, gentleman; for certain improvements in propelling Vessels. Dated September 8, 1825.—In two months.

To William Jeffries, of No. 16, London Street, Radcliffe Cross, in the parish of Radcliffe, in the county of Middlesex, brass manufacturer; for a Machine, or Impelling Power, without the aid of fire, water, or air. Dated September 15, 1825.—In six months.

To Jean Antoine Teissier, of Tottenham Court Road, in the county of Middlesex, gentleman; who, in consequence of a communication made to him, by a certain foreigner residing abroad, is in possession of certain improvements in Steam Engines. Dated September 15, 1825. In six months.

To Cathcart Dempster, of Lawrence Pountney Hill, Cannon Street, in the city of London, gentleman; for improved Cordage. Dated September 15, 1825.—In six months.

To George Holworthy Palmer, of the Royal Mint, civil engineer; for a new arrangement of machinery for propelling Vessels through the water; to be effected by

steam, or any other power. Dated September 15, 1825. —In six months.

To Adam Eve, of Louth, in the county of Lincoln, carpet manufacturer, who, in consequence of a communication made to him by William Augustus Prince, a foreigner residing abroad, is in possession of certain improvements in manufacturing Carpets; which he intends to denominate "Prince's Patent Union Carpet." Dated September 15, 1825.—In six months.

To Isaiah Lukens, late of Philadelphia, but now of Adam Street, Adelphi, in the county of Middlesex, machinist; for Surgical Instruments for destroying the stone in the bladder without cutting, and which he denominates "Lithontrips." Dated September 15, 1825. —In six months.

To Sir Thomas Cochrane, Knight, (commonly called Lord Cochrane) of Tonbridge Wells, in the county of Kent; for a new method of propelling Ships, Vessels, and Boats at sea. Dated September 15, 1825.—In six months.

To Charles Jacomb, of Basinghall Street, in the city of London, wool broker; for certain improvements in the construction of Furnaces, Stoves, Grates, or Fireplaces. Dated September 15, 1825.—In six months.

THE

TECHNICAL REPOSITORY.

LVIII.—*On the superior advantages of Chain-Cables, Iron-Tanks, &c. By Captain* BASIL HALL, *R. N. and F. R. S. In a letter to Professor* JAMESON*.

SIR, *Dunglass, August* 24, 1825.

ALTHOUGH I cannot give you by any means so complete an account, as you require, of the admirable invention of chain cables, I shall be happy to extract from notes which I have made, from time to time, a few particulars calculated to give you the information you want.

In the first place, there is no doubt that Capt. Samuel Brown is the inventor of the chain cable, and that he is the person who has the merit of proposing its introduction in the navy. In January 1808, Captain Brown suggested the advantage which would arise from employing iron-cables as well as iron-rigging. In February of the same year, he took out a patent for this invention. About the same time he went to the West Indies in a ship in great part rigged with iron, and fitted with cables of the description he had proposed for general adoption. The result of this experiment was considered so satisfactory, by a committee of naval officers directed to inquire into the subject, that two line-of-battle ships, a frigate, and a sloop of war, were ordered to be supplied with chains of 100 fathoms length.—In 1811, several frigates and sloops were fitted in like manner, and the success which attended these early expe-

* From the *Edinburgh Philosophical Journal*, for October last.

riments, though, from prejudice and ignorance, attended with occasional difficulty, gave reason to believe that, in process of time, the substitution of iron for hempen cables would become, if not universal, at least nearly so. In 1812 Captain Brown devised a new method of closing the links at the side, by means of a long scarf, which rendered the welding more secure; and it has been found, since that time, that when these cables are exposed to a strain, sufficiently great to break them, they do not give way at the point where the links have been welded in this manner. Captain Brown adopted various forms in the links of his cables: at first they were twisted, and without what is called a stay-pin, or internal support across the middle of its length. In the same year Captain Brown availed himself of the powerful aid of the hydrostatic-press, and devised a proving machine, by which every cable, before leaving the manufactory, was subjected to a severe test; and since the introduction of this contrivance, the accidents formerly complained of, have very rarely been heard of. So far there is no dispute as to the originality of Captain Brown's inventions. He obtains accordingly full credit for them, and certainly deserves the gratitude of the country. What may be still more satisfactory to hear, perhaps, he receives from every corner of the globe the heartiest thanks of the practical seaman, from whose mind this admirable invention takes away a thousand anxieties, and gives him rest and security at moments when the horrors of shipwreck would stare him in the face. No one, indeed, but a person who has navigated on rocky and stormy coasts, or even in milder regions, but where the ground is thickly set with coral reefs, utterly destructive to hempen-cables, but which make no impression on the chain, can have any conception of the superiority of the one over the other. It is often absolutely indispensable to come to an anchor; and there are numberless occasions when the safety of the ship and crew depends wholly upon the cable not breaking; no one, I repeat, but a sailor,

can enter fully into the painful anxiety of such moments, or judge of the fatigue of watching, through the long dark nights of high latitudes, for the fatal event, hanging on a few threads, perhaps worn and rotten, which is instantly to decide the fate of all on board. Captain Brown's chain never wears, never rots, is never cut by coral reefs, is always fresh and efficient, and is, perhaps, the greatest boon given to seamanship in modern times.

It was not to be supposed, however, that an invention of such extensive practical utility would be allowed, in this country, to remain in the hands of one man, or that the ingenuity of others would not improve upon the original idea. Accordingly, early in 1813, Messrs. Brunton and Company took out a patent for an improved chain-cable. This improvement was said to consist in having the links formed in one plane, in contradistinction to being twisted, with the important addition of a stay-pin across the link, not sharp pointed, but broad at the ends. These are the description of links now universally manufactured by Messrs. Brunton and Company, as well as by Captain Brown and others: nor does it appear that there is left any thing further to desire on this branch of the subject.

The originality of this very great improvement is claimed for Captain Brown, by Mr. Knowles of the navy-office, in his published work, "An Inquiry into the means which have been taken to preserve the British Navy." This statement led, in 1821, to an angry controversy between Mr. Knowles and the patentees alluded to. This controversy does not leave the question very well determined, though it might certainly have been settled with a tenth part of the writing, by an appeal to facts, which must be on record somewhere. At all events, whichever party be right in this particular, the great honour due to the original discoverer belongs indisputably to Captain Brown.

The following list shows the size of the chain-cables supplied to his majesty's ships.

Size of Hempen-Cable.		Diameter of Iron forming the links of the Chain-Cable considered equivalent to and supplied instead of Hemp.
25 to 23	Inches.	$2\frac{1}{8}$ Inches.
22	21	2
20	$18\frac{1}{2}$	$1\frac{7}{8}$
18	$17\frac{1}{2}$	$1\frac{3}{4}$
17	$16\frac{1}{2}$	$1\frac{5}{8}$
16	15	$1\frac{1}{2}$
$14\frac{1}{2}$	14	$1\frac{3}{8}$
$13\frac{1}{2}$	13	$1\frac{1}{4}$
$12\frac{1}{2}$	11	$1\frac{1}{8}$
$10\frac{1}{2}$	10	1
$9\frac{1}{2}$	9	$\frac{7}{8}$
$8\frac{1}{2}$	$7\frac{1}{2}$	$\frac{3}{4}$
7	$6\frac{1}{2}$	$\frac{11}{16}$
6	5	$\frac{5}{8}$

150 fathoms, or $1\frac{1}{2}$ cable, are allowed to all ships of the line; 200 fathoms, or 2 cables, to frigates, sloops and brigs; but small vessels, with complements under 60 men, are supplied wholly with iron-cables.

The method of using chain-cables in place of hempen ones, is daily better understood; and their great value generally acknowledged, even by those who have not acquired a thorough knowledge of all their merits. No ship now-a-days, would be considered safe without at least one such cable. They are exceedingly convenient in practice, and are applicable, with certain modifications, to almost every variety of circumstance. If once duly put to the proof, they may be relied upon, ever afterwards, with confidence; and in this property consists their chief excellence over hemp. The value of an ordinary cable decreases with its age, even supposing it not to be in use. But if it be used at all, even in the least destructive cases, in fine weather, and in good anchoring ground, still it infallibly deteriorates;—the mere wetting and drying,—the necessary wearing in the hause-hole,—the friction of the messenger and nippers, are all inevitable sources of destruction, which no care can exempt it from. Against all these evils, the chain is by its nature entirely free. This being the case, the method of estimating the relative strength of the two, by fixing a new cable to a new chain, and straining them till one or the other

breaks is unfair. Let an old chain and an old hempen cable be tried together, and what will be the result? In point of fact, no such trials can ever afford a fair comparison; because the wear and tear of no two hempen-cables is alike. One may be in use six weeks and be scarcely the worse, while another may be rendered useless in six days, or in six hours; under circumstances which no degree of professional skill can foresee, or guard against. While under the very same circumstances, the chain, if it stand the trial at all, may fairly be described as being better after the experiment than before; in as much as the discipline it has undergone shows its powers. To ships cruising in the channel, within a few hours sail of a dock-yard, this consideration may be of little consequence; for as soon as the cable is chafed, a new one may be procured. But on foreign stations, especially those without dock-yards, or where, as in South America, the stores required are not to be procured at any cost, the question becomes a vital one. There are many enterprises of the greatest pith and moment, which cannot be undertaken if the ground-tackling be not trustworthy; and innumerable commercial speculations are put to imminent hazard, or altogether prevented, by the absence of secure means of anchoring at all seasons, and on all descriptions of coast.

In an economical point of view, the advantage to the country in the equipment of his majesty's ships is very great. As an example, I may state what came under my own knowledge on a recent voyage which I made to South America. We sailed in his majesty's ship Conway from Portsmouth in July 1820, and returned to England in the beginning of 1823, having been in commission somewhat more than two years and a half. In this interval, the ship visited thirty-six different sea-ports and road-steads, and many of them repeatedly; besides which, there was a good deal of coasting and river navigation; upon the whole, there was probably more than an ordinary proportion of anchoring than is usual in the same length of period. Judging from

experience in similar climates; I should say that six new cables of the best description of hemp would have been completely worn out by the same service, the cost of which could not have been less than £650. But in consequence of our having an iron cable to perform the greater part of the work, a single hempen one in addition was found quite sufficient. This cable, as may be supposod, was completely worn out; while the chain, costing originally less than £200, was returned into store as good as ever, with the advantage of having been well tried during the voyage.—Had I been ordered to re-equip the ship for service, I should certainly have applied for this old chain in preference to a new one.

During the voyage in question, it often became advantageous to the public service to anchor in particular parts of a harbour, where the bottom was rocky, and in situations where the best hempen-cable would have been chafed through in a single tide. At others, we were enabled to lie in security upon open coasts, which, previous to the introduction of chain-cables, no ship dared to approach. I have frequently, also, seen merchant ships trading on such coasts to great purpose, when other vessels, equally well circumstanced in other respects, were obliged to relinquish considerable mercantile profits for want of this single article in their equipment. Important advantages, therefore, belong to its use besides the saving of cost, which is very great.

Some practical details may perhaps interest you. It is troublesome to use a chain-cable in water above twenty or twenty-five fathoms in depth; for its weight, added to that of the anchor, makes it sometimes a difficult affair, and always a tedious one, to heave it up. Some years ago, when I was inexperienced in the use of the chain, I had occasion to anchor on a coral bank in the China seas, in about thirty-five fathoms water; not reflecting on the momentum which the chain would acquire in descending through such a space, I omitted the proper precautions, and the whole

hundred fathoms in length were carried out of the hause-hole with increasing velocity, and a furious noise, till at length, brought up by the clinch, when the jerk shook the ship from end to end: the whole being the work of not many seconds, though causing a commotion truly astounding to all who like myself saw it for the first time. It employed us four hours hard work before we recovered our anchor. I have not seen any contrivance in our ships for anchoring with the chain-cable in deep water; but on board an American merchant vessel, I took notice of an ingenious device, which was said to answer perfectly, and if so, is well worthy of imitation. To the anchor was shackled in the usual way, a ten fathom length of chain, to the end of which, by means of three tails, made of small chain, attached to a swivel-ring, was spliced a hempen bower-cable. The iron part of the cable, it was said, lay on the ground, and received the chafe without injury, while the remaining length was kept sufficiently tight to clear the rocks at the bottom. At first sight it might be imagined that hemp and iron would not do well to splice together, but experience in this case, shows that it may be done without difficulty, and without injury to the softer material.

This leads to the consideration of another valuable result of experience. When chain-cables were first introduced it was supposed that a ship could not be moored by their means, unless two were used at once; it being taken for granted that if a ship were moored with a chain and a hempen cable, and that the hause became foul (the technical term for the twisting of the two cables, caused by the ship's swinging round in a tide's way), the iron would speedily cut its companion through. Ample experience, however, has shown, that so far from the chain having the supposed tendency, it has it incomparably less than the other. That is to say, two hempen cables drawn across one another, especially when wet (which they must be in a ship's hause), will chafe and wear each other through sooner than a hempen cable similarly exposed to the rubbing

of a chain. The reason is, that the links of the chain being smooth, do not act with so much friction. In point of fact, the chain has not so great a disposition to move, for its great weight makes it to lie more steadily across the other.

This valuable principle, which was quite unlooked for in the early stages of the invention, has been in some instances absurdly counteracted by the over-caution of well-intentioned ignorance. It is the universal practice, in using hempen-cables, to round them, that is, to wind round them at those places exposed to friction, a thick coating of small rope, which adds about one-third to the size of the cable, —a clumsy but indispensable precaution. The friction, therefore, of the two cables, is wasted on the rounding, while the cable itself is protected. Such precaution is clearly not wanted in the case of a chain; but people who act by what is called the "rule of thumb," and who do not inquire into the reason of any thing, think it necessary when they come to moor with one of each kind, to round the iron cable as well as the hemp; the effect of which is, to convert the smooth and harmless chain into a file of the most biting quality; and whenever a chain so armed comes to lie across a hempen cable, the destruction of the last is most rapid.

At first, it must be admitted that the iron cable is difficult to handle, but a little practice renders it wonderfully manageable. It is shackled to the anchor in a tenth part of the time spent in "bending" a cable, and, if required, is unshackled in an instant. In this respect too, it possesses a property of great practical utility; it takes no injury by being perpetually attached to the anchor,—whereas it is ruinous to a hempen cable to be long bent or fixed to the anchor, and exposed to the weather. Thus, without trouble, or any risk of injury to the cable, a ship can be kept at all times in a state of readiness for anchoring —an advantage which practical men well know how to appreciate, and the neglect of which has led to many a shipwreck.

The least expensive method of mooring a ship is with

two chains, and the time is probably not far distant when this will be done universally. On the South American station, where the weather was generally fine, a bower-chain to sea-ward, and the stream-chain towards the shore, was found sufficient, and, in this case the wear and tear was nothing. Sir Thomas Hardy, to whom the navy, and indeed the profession generally, are indebted for so many useful inventions, contrived a simple method of mooring with two chains, so that the hause was never fouled, however many times the ship swung round. This consisted in unshackling the stream-chain from its own part, and again shackling it to one of the swivel rings, which occur at intervals on the bower chain. Thus the ship rode, as it were, at moorings, the portion of the bower-chain above the water's edge becoming a bridle; an explanation which will be understood by every practical man. The same officer has also contrived a double bridle for riding a ship by the middle of a cable or between two bower-cables: and it is probable that all his majesty's ships will eventually be supplied with these valuable additions to the chain. It may be said that these things are perfectly obvious, and that little credit belongs, therefore, to the discoverer; but the same is equally true of the chain cable itself, sufficiently obvious now it is pointed out. But it is the peculiar province of genius to turn those principles to account which ordinary men are trampling under foot. Simplicity, indeed,—which is the most common characteristic of such adaptations,—applies peculiarly to all those of the officer in question, and to none more than to his stopper for the chain cable, a contrivance not generally known, but meriting a particular description.

On the under side of the beam, which forms the foremost part of the hatchway, where the chain-cable comes up, is fixed a strong crane-necked hook of iron, nearly as thick as a man's wrist, and about as large as the circle which a man can form with his arms when his hands are joined together. One end of this curve is attached to the beam, but is allowed to be moved round the bolt freely in a horizon-

tal plane. The cable is supposed to come up the corner of the hatchway, so that the crane-necked stopper, being placed also near the angle, is made to embrace the chain; and a strong tackle being then hooked to the end of the crane, it is boused or pulled tight on the lower deck, so as to bind the chain closely against the beam. Such is the powerful grasp of this stopper, that it arrests the chain if it be required instantaneously, whatever velocity it may have acquired,—an object which every other description of stopper has failed to accomplish.

There are still, or at least there were two years ago, several desiderata, which it would be well worth the while of the manufacturers to supply. In the *first* place, the mode of unshackling the lengths of the chain requires to be improved. Unless constant attention be paid to the pins which retain the bolts in their places they become rusted, and are not to be moved without a long process of hammering. Now, since it frequently becomes necessary to slip the cable (for it cannot be cut), the utmost facility should be afforded for disengaging one part of the cable from the other. The fault of the pins seems to lie in their being made flush with the bolt; whereas, were they prevented from coming completely through the hole, by a shoulder, which should correspond with a contraction in the hole, the pin might be reached by a punch, and readily driven out. By the present method, the hammering which is requisite, has often the effect of rivetting it more firmly in its place.

In the *next* place, every ship fitted with chain-cables, ought to have large and strong shackles fitted to the shank of the anchor, in place of the rings used for hempen cables. The short nip of the chain, on these large rings, is apt to break them. I have myself seen no fewer than four rings snapped in this way. I believe that his majesty's ships are now furnished with shackles such as I describe; but all ships ought to have them.

I have heard, that chain messengers have been introduced; but I have not seen them. It is certainly desirable

that they should be: but some contrivance will be necessary, to prevent the frightful accidents which are liable to occur in the event of their breaking. At all events, whether chain messengers be expedient or not, it seems clear that some contrivance should be sought for, by which the hempen nippers may be done away. They are not only very inefficient, but are very expensive. Something on the principle of the iron claws, by which great stones are grasped and lifted, might easily be adapted to this purpose.—I allude to those pincer-shaped implements, which clasp their object more firmly the more they are pulled upon. The tails of these nippers might be of the usual kind, especially if the messenger were also of hemp; and I have great doubts about the successful application of iron to this branch of the subject, where the risk of injury to the people employed is so great, and, as I think, unavoidable. It is sufficiently serious when a hemp messenger breaks, but the breaking of a chain would sweep every man off the deck. It is worthy of the attention of an ingenious man like Capt. Brown, to overcome this difficulty; and, perhaps, it may be possible, by some mutual adaptation of the different principles of rope and iron, to place a chain in the middle of the messenger, like the heart in a four-stranded rope, and thus to gain the strength of the one, without losing the friction and the protecting quality of the other.

In reply to your queries respecting the various other uses to which iron has been applied of late years in nautical affairs, I have little to say, as I fear I have already greatly exceeded your limits. I shall, therefore, merely allude to the most remarkable. These are,—spindles for capstans,—shrouds for masts,—bobstays and gammoning for bowsprits,—topsail-sheets and ties, (but this, I believe, is in the merchant service alone, though worthy of imitation in the navy), oil and varnish barrels, and many minor purposes, all conducing more or less to the efficiency of ships having long voyages to perform. But one of the earliest and still the most important uses of iron, was the four feet

cubes or tanks for holding water, a great blessing to the seafaring community. By means of this contrivance, water may be kept for any length of time, without the slightest contamination. I once filled a tank with clear water at Portsmouth Harbour, and having carried it four times across the torrid zone, and round Cape Horn, over a greater distance than the circuit of the globe, brought it back again more than two years afterwards in the same tank, not in the least degree discoloured, and in all respects as good as when it was first taken up from the spring.

LIX.—*Specification of the Patent granted to* EDWARD CHARLES HOWARD, *of Westbourn Green, in the County of Middlesex, Esquire; for Improvements in the Processes described in the Patent granted to him the* 31*st of October*, 1812; *for a Process for Preparing and Refining Sugar, and certain Apparatus for carrying the same into effect.* Dated November 20, 1813.

(Concluded from page 228.*)*

WITH A PLATE.

AND I further declare, that the density of the solution required to be produced by evaporation may be ascertained by the use of the several parts of the apparatus hereinafter described, by the common trial or proof of tenacity, or other variable quality. And the same may also be known by means of a thermometer immersed in the said solution, by observing the temperature at which the solution, while fluid and without grain, can be kept boiling under different pressures, the said pressures being shown by any gauge or fit instrument denoting pressures, and communicating with the vacuum; for the said fluid solution will be in the state I prefer as fit to be drawn off, and set for the ten-pound sugar loaves, called Hambro' loaves, when the half pressures upon the mercury, in a common mercurial syphon gauge, mea-

sured from the line which is equidistant from each of the mercurial surfaces, (or the line of perfect level,) and the temperature of boiling, by Fahrenheit's scale, set opposite thereto, are respectively and nearly as shown in the following table:

Half Pressures by the Guage in Inches and Hundredth Parts.	Corresponding Temperatures, or boiling Points of Fahrenheit's Scale.
0,74	115
0,86	120
1,01	125
1,17	130
1,36	135
1,57	140
1,80	145
2,05	150
2,36	155
2,72	160
3,10	165
3,52	170
4,00	175

And the intermediate pressures corresponding with the single degrees of temperature may, if required, be found quite nearly enough for practice, by the interpolation of the differences of the numbers in the said table; and that I have not stated the pressures and temperatures for lower stations of the gauge than 0,74 inches, because I have never performed my whole work at lower temperatures than 118 degrees, and have reason to doubt whether the ebullition could conveniently, or even practicably, have been carried on throughout under lower pressures, chiefly on account of the great perfection of the pump, or other exhausting instrument, which I conceive would be required for the ebullition at such low pressures; and I have also,

given the several half pressures above 2,05 inches, with the corresponding boiling points, although the same may in some cases require correction by the operator in his practice with or upon different kinds and quantities of sugars, because I have not usually worked with such imperfect vacuums; but the whole table will be found useful and advantageous in directing and assisting the operations of any competent workman in the art of refining sugar, in carrying my said invention and improvements into effect and practice.

Fig. 6, (plate IX.) in the drawing hereunto annexed, represents a syphon gauge, with the intervals of pressures or stations of the mercury set off, and the corresponding boiling temperatures expressed in numbers, so that whenever the mercury in the gauge stands opposite any division, number, or degree, the solution will be ready for drawing off, as aforesaid, for a Hambro' loaf when it boils at that number or degree of the thermometer. And if it be desired to reduce any saccharine solution, mélasses, or treacle, to a solid, or comparatively dry mass, either with a view to save drainage, freight, or carriage, or other advantage, I do carry on the evaporation (with as little interruption as possible) in my said apparatus until any such solution acquires such solidity or comparative dryness, when it will become necessary to extract it by force; and I ascertain the progress and approach to dryness of that solution by the inspection and examination of samples, which I from time to time take out of the evaporation vessel, with the instrument hereinafter described, for the like purpose. And forasmuch as a thermometer is liable to be broken by being exposed naked within the boiler, and it must nevertheless be in as perfect contact as possible with the boiling sugar, I do by preferance inclose the bulb, and such part of the neck thereof as is not required to be seen, in a metallic tube, by preference of iron, tinned externally, and screwed, soldered, or otherwise inserted, air-tight, into the boiler, and having the lower end thereof perfectly closed, and descending sufficiently low to be always immersed in the boiling

sugar. And, in order to perfect the contact or communication between the metal of the said tube and the bulb of the thermometer, I pour as much mercury into the tube as will cover the said bulb. And, in order to take samples of the solution from time to time from the said boiler, for the purpose of making trials of the tenacity or other variable quality indicating the density or approach to dryness of such solution, or for any other purpose, without forming an immediate communication between the boiler and the external air, I do make and use a pipe, represented by 4, 4, 4, 4, in fig 5, (plate IX.) hereunto annexed. And the said tube is inserted, in an inclined position, through the side of the said boiler, with the inner end thereof lowest (18, 18); and I do secure the joining or place of insertion (21, 21) by screwing, soldering, or by any other means which will keep the juncture sound and air-tight; and I do leave the outer extremity of the said tube open; and I do so dispose the inner end thereof as that the same shall be immersed in the saccharine solution; and I do close the said end, but I leave a slit or aperture (No. 19) in the upper side thereof, of at least half an inch in its smallest dimensions. And I do accurately fit within the said inner or lower end (18, 18) a short piece of tube, capable of moving by rotation, in the manner of the pin of a cock, (8 to 15, in fig. 1,) but concentric with the other tube, and limited by stops or studs from revolving through more than about half a turn. And I do make in the said short piece a slit or aperture (13) to correspond with and afford a communication through the slit or aperture (19) in the tube so fixed as aforesaid, at such time as by the rotation of the said short piece both slits or apertures shall be placed opposite to, and communicating through, each other. (See the section fig. 3.)

And, further I do make a plug or piece to be put into, and nearly, but not precisely, to fill or fit the cavities or internal spaces 22 in fig. 5, and 12 in figs. 2, 3, 4, within the said tubes, and so formed or provided with notches,

studs, or the like means, as to take hold of or become connected with, and, if required, to turn the said short tube whensoever the said plug or piece shall be thrust home to its place, or nearly so. (See the parts coloured blue in all the figures, and marked *c* in the plate.)

And, moreover, I do make an excavation or cell within the said plug or piece in the part thereof which is or may be opposite to the slit or aperture (13) in the short tube, when both the said tubes and the said plug or piece are or may be in connexion as aforesaid, and communicating through the said slit or aperture, and in consequence hereof it will ensue, that whenever the respective slits or apertures in the said before-described tubes or pieces shall or may be made to correspond with, and afford a communication through, each other; then the said excavation or cell will also communicate with, and become filled with, the saccharine solution, and the plug may be taken out.—But, in order that no communication should take place with the external air whilst the said plug is turned round, or whilst the excavation thereof communicates with the said solution, I do accurately fit the said piece or plug within the said first-mentioned external tube by a conical portion of both (3 3 and *a a*) at or near the external end of each.

And, further, in order that the motion of the short piece of tube may not be obstructed by the adhesion of the saccharine solution when become viscous and tenacious, I do make a groove or grooves (10, 11) on the surface of the said short piece, as practised in the axletrees of some carriages, and fill the same with a mixture of wax and grease.—17, 17 denotes a binding nut for setting fast the screw 16, 16. And the act or operation of charging the said plug or piece and taking out a sample of the saccharine solution, is performed as follows: I thrust down or home the piece or plug, as shown in the section fig. 2, and turn the same to the position fig. 3, in which the aperture of the cell or cavity (6) shall be uppermost, and consequently that cavity

will become charged: and then turn the plug back to the situation shown fig. 2, which closes the communication through (19), and then withdraw the plug just sufficiently to disengage the same from the short tube; and this last-mentioned tube consequently remaining shut, I return the piece or plug to its former situation with the aperture of its cell or cavity uppermost, as shown in fig. 4; and by withdrawing the plug with its cavity *b*, I do take thereout the sample required. But I hereby declare, that my invention, for which this present patent is obtained, in so far as regards my last-mentioned improvements upon my former process, does consist in the evaporation or concentration of the saccharine solution by the application of heat to the said solution in the vacuum, and in the maintenance of the said vacuum by the continued action of a pump, or other exhausting instrument, although the common gauge should indicate no change. To which operation it is subservient, that I have herein pointed out a method of ascertaining from time to time the density of the said solution by comparative observations of the boiling point and pressure, without drawing off any of the said solution, although I have also shown in what manner such portion of the solution may, if required, be conveniently drawn out by a particular instrument.

And, further, I do declare, that having brought the solution or liquid sugar, by due evaporation, to the density required for its intended purpose, I withdraw it, by a convenient and proper aperture, from the boiler into a granulating vessel, in the nature of that now commonly used as a cooler, which I construct or fit up capable of being heated by preference with steam, applied to its external surface, or other fit means. And I do therein so regulate the temperature of the said liquor, that it may undergo the requisite or usual stirring to effect granulation, and that it may be also sufficiently fluid and sufficiently cool to allow the particles thereof to arrange themselves in crystalline grains, to which I find they have the most tendency between the

degrees of 150 and 160 of Fahrenheit, inclining to the one or or the other in the ratio of the density of the said evaporated liquor. But since, in practice, this granulation is most advantageously accomplished by alterations of temperature above and below the said last-mentioned degrees, I do in preference, upon the said liqnor being drawn off as aforesaid, heat up the same (as soon as it has acquired some grain) to about 180 degrees, either by withdrawing the application of heat, and stirring out or allowing the escape thereof, or by the addition of a due quantity of colder evaporated liquor, as it has been usual to give heat by what is called skippings, or by both, or any other fit means; and I do again elevate the temperature as aforesaid, and I repeat and vary such alterations of temperature, until the sugar has formed itself into the best grain of which it seems capable to the experienced workman, who may, after some practice in this my process, be able to judge by the eye, of the best temperatures and fluidity, even without the use of any thermometer, although I do recommend its constant use. And when I apply heat to the said evaporated or granular liquor for the last time, I do by preference raise the same up to nearly 200 degrees, and not higher; and I do fill the moulds therewith, employing either those in common use or those directed in my said specification, or those hereinafter described; for, in the event of its being required to retain the point of the lump, loaf, or mass, without returning the syrup contained in that point upon the body thereof; I do, as one of my said improvements, instead of employing a mould, with the appendage of a pipe, as described in the said specification, employ moulds, purposely made of greater length than usual, in order that the point of the lump, loaf, or mass, to be in them contained, may have as much of its pointed end cut off as will not part with the syrup, which I accomplish by a revolving instrument, resembling a chuck in the art of turnery, and made concave, and provided with a side cutter within. And the said instrument is made to revolve by the mandril or axis

of a turning-lathe, duly fitted up, and is of such a figure (nearly approaching that of a hollow cone) within, as to take away that extraordinary length of point in which the syrup is chiefly lodged, and to leave the loaf of the regular length and of the shape which may be required or preferred in the market. And I do use and apply the said instrument accordingly. And in all cases, not especially mentioned, I do proceed according to the practice of sugar-refinement as now used, subject to the directions herein, and in my specification declared; but I hereby declare that my invention, for which this present patent is obtained, in so far as regards the last-mentioned improvement upon my former process, which relates to the granulation or crystallizing of sugar, does consist in substituting for the method of skippings, used in the ordinary process, and for the method in my former specification mentioned, the application of different degress of temperature alternately, to the same mass of evaporated or concentrated saccharine solution.

And, I do declare, that my said invention, taken collectively, does consist in the application and use of the method herein before set forth, by which certain principles, or general facts, in part well-known, are brought into practice and effect in the process of manufacturing sugars; and that my said invention of the improvements aforesaid, and the several parts, manipulations, or proceedings thereof, may be carried into effect and practice, either wholly or separately, without conjunction, or in conjunction, with the methods of sugar-refining already in common use, or in the said specification described and set forth. And that the management thereof, the several proportions of materials or ingredients, the furnaces, vessels, or apparatus to be used, and the needful attentions to local and other circumstances, are all susceptible of variation, according to the exigencies of the respective works or operations; but that the same are either well known, or may with facility be made or adopted from the instructions contained in these presents, and in my said specification before mentioned, by

any competent workman, or other person or persons acquainted with the general course and nature of manufacturing works, and particularly with the present art of refining sugars.

LX.—*Observations on the different Modes practised in husbanding flax in Ireland. By Mr.* WILLIAM SALISBURY.

DEAR SIR, *Brompton, Oct.* 15, 1825.

IN continuation of my remarks on the culture of hemp and flax*, I shall now proceed to treat of the various practices employed in husbanding flax in Ireland.

Flax, *(Linum usitatissimum).*—There is no product of British or Irish agriculture so uncertain in its results as the one in question; for, although the crop may be grown to perfection, in any part of Great Britain or Ireland, yet the operations for extracting the fibres depend in great measure, upon chance circumstances.

The means usually adopted are, to put the crop into water as soon as it is pulled from the ground, whereby a decomposition of the vegetable is effected, and the fibres of the flax are partially set free; this operation, however, is governed by the state of the weather, the peculiar quality of the water, and the point of maturity at which the plant had arrived. For the better elucidating this part of my subject, I shall detail the natural formation and component parts of the flax plant, agreeably to the laws whereby vegetation in general is governed.

A plant is ordinarily composed of a root, a stem or stems, and, probably, of branches, leaves, flowers, and seeds; these, when examined chemically, are formed of a great variety of parts, differing in their nature and quality, and peculiar to plants of different kinds: thus, tannin is secreted in the oak; turpentine in the fir, &c. &c.; besides which, there

* See Vol. VI. page 261, and Vol. VIII, page 174.

are distinct substances, common to these, and all other forest plants; these differ in their form, according to the habit of growth in each kind. These different parts increase in bulk accordingly as the plants imbibe nourishment from the ground.

This food is taken up by the roots in an aqueous state, and is carried up a set of vessels, destined to this purpose, to each separate leaf; and, entering each, through its foot-stalk, passes to its upper surface; and when thus exposed to the action of the sun, a natural distillation takes place; whereby the aqueous particles are separated and filtered through the pores of the leaves: the food, thus concentrated, is conveyed down the other parts of the plant, by the aid of another set of vessels, known by the names of sap, or blood vessels. We have thus a clear idea of three distinct substances in every plant:—

First, the food of the plant, which, after being thus prepared, will be found to have a mucilaginous appearance.

Secondly, the ascending vessels, by which the food is first taken up in the roots, and conveyed upwards:—and,

Thirdly, the descending vessels, whereby the food is distributed over the stems, and into all the other parts of the plant.

It would require a long and intense research into the principles of botanical and chemical science, and particularly into the physiology of vegetation, to trace the changes the sap undergoes, in different plants, and how it becomes the most nutritious food in some, and is converted into deadly poison in others.

In flax, the ascending vessels are found in the form of wood, in the interior of the stem, which, in general, is single and upright; but the descending vessels are lodged in the bark, and these too, are surrounded by the mucilaginous substance mentioned above. Hence, the ascending vessels form the wood of these plants, and the descending ones the fibres, for the sake of which they are cultivated.—By chemical analysis, it appears that the stem or wood,

is a compound of tannin, resin, and iron. Now, to separate the fibres from the other parts of the plant, and to clean it from the colour it receives from the usual manipulations, have formed the arts of flax-dressing and bleaching, ever since time immemorial.

If the separation of the fibres be effected, before the stems of the flax are steeped, as they usually are, for a considerable length of time in water, the sap vessels or fibres, are colourless; and, when magnified, resemble fine transparent tubes of glass, presenting to the naked eye a perfect whiteness; and, in this state of purity, they are much stronger than after the flax has been submitted to the steeping process. This separation may be easily and completely effected by mere mechanical processes; and without the employment of any thing which will, in the least degree, affect the strength and texture of nature's originally perfect texture.

The cultivators of flax in the South of Ireland are very numerous; almost every person there holds more or less land, and they are now in the habit of growing small quantities. But scarcely any two samples of flax are found alike, after being taken out of the steep. The fermentation being carried too far, will render the parts of the plant so tender as to approach putrefaction; so that no means can be used to scutch and clean the fibres, without a considerable waste. If the fermentation, on the other hand, be not carried far enough, then the plant is rendered too tough in the stem to be scutched, without the previous aid of heat to dry it; but which makes the whole brittle.

After the flax crop has been steeped and dried, it is usually beaten with a wooden mallet, and afterwards scutched, with a rude implement, called a *cleve*, whereby it is rendered tolerably clean. This domestic tool is, however, complained of, as being very ineffective; and, in some cases wasteful. It would, indeed, be impossible to invent an instrument that would universally apply to a substance so much subject to a change of texture.

Within the last two years, scutch-mills have been recommended to be erected in particular districts, under the erroneous idea, that their operations could be performed in a more economical manner; in such places, the tenantry are enjoined, by their proprietors, to send their flax to those mills. The usual price charged for scutching is one shilling and one penny per stone; which, with the expense of carriage, to and from the mills, incurs an expense of from twenty to twenty-five per cent. upon the poor farmer's crop! A mill of this description, when fully employed, will yield to its proprietor, clear of all expenses, at least four hundred pounds per annum!

In a series of experiments, which I had made at one of these mills, under my own inspection, and upon seven different parcels of flax, as sent in by the farmers; some of those specimens yielded two stone, from the hundred weight of flax, from the steeped flax plants; others eight pounds only, and the average of the whole was not above seventeen pounds of good flax, from one hundred and twelve pounds of the dried stems! Thus, in many cases, the poor grower did not obtain a return *equal in value to the cost of the seed he sowed*; a circumstance of very general complaint among the farming community in that neighbourhood.

It appears from the report of the Irish linen board, in August, 1823, that on the preceding 6th of May, fifteen thousand pounds sterling were ordered to be distributed for the purpose of erecting an additional number of these mills; and there were also recommended to the board claims for this purpose, to the amount of ten thousand pounds sterling.*

In the same season, a new practice took place in the manipulations employed in the flax husbandry. At the instance of a gentleman in the county of Cork, two Dutch farmers were hired to teach the Irish farmers a pretended improved method, said to be practised in Holland; and one of whom had remained all the autumn of that year with the said gentleman, who had grown upwards of forty acres

* See the Report for 1823, page 144.

of flax, and was one of those who is stated in the report to be an expectant candidate for a scutch-mill. No such mill was, however, then erected, and the trial of such a ponderous implement was not, in consequence, made; or, from the sequel to that gentleman's flax experiments, a more perfect description of these two improvements would have been made; however, the effects of these pretended improvements may be calculated, from the unfortunate result, of the additional quantity of flax, raised in the province of Munster in the season of 1824.

The advantages held out by pursuing the Dutch method were, that the flax may be dried before steeping, and the seeds saved; and that, by laying the sheaves of flax regularly one way in the water, and covering the pits thus filled, with *mud*, raked up from the bottoms of other pits, the flax would be rendered softer than when covered with the stones, which the Irish peasantry were in the habit of laying upon the flax, to keep it submersed, while undergoing the steeping process. If the advantage of saving seeds is to be dwelt on, it should be in the first place considered, that, if the flax be pulled at a proper state of maturity, only a small portion of seed will be in a state fit to sow for a future crop. If, on the contrary, the flax is left growing till the whole of the seeds are ripe, the fibres will be so large, coarse, and stubborn, as not to be equal to one half their value for any purpose in the linen trade! I shall illustrate this by the following description of the natural habit of the blooming or fructifying process in the flax plant. Its flowers are produced in succession for more than three weeks, and the first flowers are succeeded by green capsules, in which may be seen the embryo seeds, even before the fructification on other parts of the same panicle has been formed; and the consequence of this, is a succession of other seeds also. Now, if the crop be pulled up at the time when the seeds in the earliest capsules are completely formed, and the cotyledons changed from the milky to the substantial state, all those will be good seeds, and fit for sowing again; but

these will be few indeed, compared with those which are less mature! It is true, indeed, that, by casting the seeds in the barn, when threshed, the heavy portion thereof may be separated, and with good effect, in those flax countries where a fine autumn prevails; but if a succession of wet weather sets in, the flax is then thrown into the steeping pools; for, if the flax be tied up in sheaves, as is done in Holland and other countries, and left for the interior to get moist, it will become mouldy and rotten, and is more liable to spoil in that state than when it has undergone the steeping process, and is afterwards laid out or spread thinly upon the ground to dry; and this is the practice in Russia, in Holland, and also in the county of Kent; while, in Lincolnshire, the farmers throw their crop of flax, capsules and all, into the steeping pools, as soon as it is pulled.

The time afterwards required to steep the flax covered with mud, and to dry the flax, after it is removed from the mud pools, with the soil attached to its stems, so far procrastinated this work, that *very little flax was saved in Munster, to any good account, during that season!*

As few persons, however, like to see their errors exposed, so I shall omit to mention the names of those who thus suffered; although I could readily point out three distinct and distant places, where, after all the expence, care, and trouble of this *tedious, expensive, and offensive process, many flax growers had the poor satisfaction of obtaining a few bushels of seed, at the expense of the loss of their whole flax crop!*

In offering this system, said to answer so well in Holland, did the projector of it consider the province of Munster as being *mountainous*, and exposed in *the south-west* to the vast Atlantic Ocean! and *that two-thirds of our winds, taking the year through, blow from that quarter!* That every twelve hours wind from thence, invariably caps the mountains with clouds, which shortly condense, and fall in heavy rain; it is, therefore, the most humid situation of any in the British possessions; and it is in this

country that the flax husbandry, even under the most favourable circumstances, and in the best applied modes, *cannot be effected with less than full six weeks fair weather in the autumn!*

Can then, I would ask, any method which shall prolong this process five or six weeks farther, operate as an improvement? Surely, on the contrary, any means of *accelerating* the process of flax husbandry, must be vastly preferable! Is it not, therefore, evident, that this Dutch system, let it be carried on in other places with whatever effect it may, is the reverse of what ought to be promoted in Ireland, from the longer time it necessarily takes to bring the flax crop into a marketable state. It would have been better to have let the Irish flax growers in Munster, at least, follow the safest way; that is, if it needs must be subjected to the *steeping* process, let it be done *in the shortest possible time*, lest the autumnal rains spoil the whole crop.

In the same season that *my new British system of flax dressing* was tried in the county of Cork, and which system consists in merely beating the flax stems, when dry, with a proper implement, which separates the fibrous from the woody parts of the plant; some flax was prepared in this way, which had been dried by the Dutch farmers, and was ready for the steeping process; and was also spun into yarn, washed half white, and sent to Messrs. Dimsdale and Clerk, of Bucklersbury, London, and who have the sample still by them. They immediately offered me more money for it than any other Irish yarn of the same quality and size was worth at that period; and their answer was received back from London by me, in Ireland, before even a single steep of flax had been taken out of *the Dutch mud-holes!* And which flax, indeed, was not even dried on the fifteenth day of January, 1824; when what was not quite rotten was drying on that and the succeeding days, by means of fires, lighted between two stone walls; the flax being suspended upon hurdles, laid over the walls; and,

when dried, was to be scutched according to the Dutchmen's directions, in the old manner, so accurately described and reprobated in the late Mr. Marshall's work "On the rural economy of Yorkshire."

The *deleterious effluvia* produced from *the large masses of putrefying vegetable substances, during the steeping and drying processes*, have long been complained of *as destructive to health*; and the legislative authority has been called in to render this process as little inconvenient to the public as possible. Yet, although magisterial influence has checked the evil in some measure, it has been the cause of cattle being poisoned near Mallow, and is described by some of the most eminent physicians in London, as being the predisposing cause of putrid and malignant fevers.

In the humid climate of Ireland, the flax, in the winter months, must be dried before it can be broken and hackled; and, in the cabins, a frame of wood is put over a turf fire, around which the poor family sit, while the noxious effluvia from the steeped flax are driven off by the heat, and contaminate, not only the atmosphere in the cabin, but also in the open waste surrounding it! Its smell is quite bad enough, when the Irish peasant is steeping his flax in the water, and is poisoning the air around his dwelling; but it is much worse for him to be condemned to employ fire to dry it afterwards, and to breathe, at the same time, the pestiferous fumes exhaled from it, and the mud adhering to it!

Supposing that the culture of flax was about to be introduced into any new country, where the husbandry of it was to be learned by the people, is it likely that, with the above recited facts, and plain statements before them, they would adopt either of these Dutch or Irish methods of steeping, to extract the fibre; when *the new dry mode* is, in all respects, much more easily and quickly accomplished, and is known to produce a much superior article, and which never need be placed in water at all till put into the hands of the bleacher; when, only with the application of soap and water, it may be washed white in a very small time?

In recapitulating the above facts, we find that, by the *Irish* method heretofore practised, the flax is steeped in water, and the iron, tannin, and mucilage in it, changes the water into *ink*, and thereby *dyes* or *stains* the fibre to that degree, as to require *a powerful chemical bleaching* to discharge the colour so acquired. That by the *Dutch* method, the noxious business of steeping the flax is procrastinated six weeks. That by *the new British process* the flax may be harvested without being subjected to those deleterious processes, with a greater degree of quickness and certainty; and that the bleaching it white is effected without the use of those destructive means which the steeped flax requires. And, moreover, that in the breaking of flax by the new British process, there is no occasion for the employment of scutch-mills: as all persons can prepare their flax in their own cabins, and at those times, when either bad weather or the want of day-light, prevent their following their usual avocations.

The South of Ireland is by no means to be considered as equal, in point of improvement, with the North;—the flax husbandry is new to almost every one there. Three harvests of flax have now passed since these remarks were written in that country, viz. those of the years 1823, 1824, and 1825. The gentleman who grew the forty acres of flax, has never sown any since, although he had the advantage, if such it may be termed, of having the Dutch farmer reside constantly at his farm for six months. The expence of cultivating an Irish acre of flax cannot be estimated at less than twelve pounds sterling; and thus he had fully four hundred pounds at stake, besides the loss of his rent, and had also those taxes to pay, which would otherwise have fallen upon his tenants. I have made enquiries every season, as to the state of the culture of flax in Ireland; and each result seemed more and more to convince me, that the introduction of the absurd Dutch practice of *covering the flax with mud* in steeping it, would end in inducing persons to relax in their exertions to forward this important branch of agricultural economy. Mr.

Becher, member of parliament for Mallow, has lately written to me, and states that less flax than usual has been grown there this season.

I shall furnish you with some observations on the present *destructive system of bleaching flax* in my next, in continuation of this subject, and remain,

Dear Sir, your's very truly,

To T. GILL, *Esq.* WILLIAM SALISBURY.

LXI.—*On a new Reflecting, Compound, and Single Microscope, in one Instrument; invented by Mr.* JOHN CUTHBERT, *optician and philosophical instrument maker.*

MR. Cuthbert, of Bishop's-walk, Lambeth, whose ingenious combination of the hydro-pneumatic blow-pipe, and pneumatic trough and tray, in one apparatus; and of a gas-holder and pneumatic trough in another, we have already described,* has recently favoured us with a sight of the extraordinary effects produced by his new reflecting microscope, and which he originally executed on the plan recommended by Dr. Goring;† but which he has now greatly extended, so as to combine the above-mentioned three instruments in one.

The reflecting part of this instrument consists of a concave elliptic speculum, of six-tenths of an inch focus, and three-tenths diameter, mounted at the farther end of a short conical tube, which is screwed into the cylindrical body of the microscope; near to the concave speculum, an aperture is made in the side of the conical tube, through which the image of the object to be viewed, is received upon a very small plane diagonal speculum, and by it reflected into the concave speculum, from whence it is transmitted through the body and eye-glasses, to the eye of the spectator, in a greatly magnified state. Upon the conical tube, a triangular bar is fitted, at right-angles to it, having

* See Vol. V. page 326. † See Vol. VII. page 301.

a sliding carriage upon it, with a very fine rack and pinion, to adjust it accurately; and to the carriage, or stage, fitted up with a springing plate, to hold the sliders with objects in them to be viewed, can be adjusted; or the stage can be removed, and an improved forceps substituted in their place. Upon the triangular bar, an illuminating concave speculum, mounted in a swinging adjusting frame, can be slided, when required to concentrate the light, in viewing transparent objects. And also, upon the conical tube, an illuminating lens, mounted in a swinging frame, can be fitted, to increase the light in viewing opaque objects; and which, as the object, however highly magnified, never approaches nearer to the conical tube than the tenth part of an inch, can be readily effected.

The cylindrical body of the microscope is received into the cleft-jointed socket of the usual telescope-stand, fitted up with a binding-screw, mounted upon three folding legs, and furnished with a turning joint for changing the position of the body from a horizontal to a vertical one, or any intermediate one, at pleasure; the joint is also mounted upon a cylindrical tube, sliding in another, to which the legs are screwed, and thus permitting the body of the instrument to be elevated or depressed, or turned in any horizontal or other direction at pleasure; and as it can also be turned round in the cleft-socket, so it admits of every possible variety of position; and can either receive the direct light of the sun, day-light, or of a lamp or candle, as may be eligible; or their reflected light from the speculum.

The magnifying power of this reflecting microscope is considerable, and it is varied and very greatly increased, by applying different eye-glasses, as in the astronomical telescope; and, therefore, to render the instrument also equally useful for lesser magnifying powers, Mr. Cuthbert has contrived to remove the reflecting part from the body of the microscope, and to substitute for it a short tube, into which the usual buttons with object glasses can be screwed, as in the common compound microscope; the

adjusting stage and forceps, and the illuminating speculum, being also equally applicable to the microscope in this state. And, to render the microscope an universal one, he has fitted a ring, with a screw inside of it, to the triangular bar, and the latter to the body of the microscope; and he thus converts it into a single microscope, or megalascope; the buttons with the object glasses of the compound microscope, screwing into the ring, or lenses of less magnifying powers, being substituted in place of them.

We certainly have never witnessed such effects produced by any microscope as by Mr. Cuthbert's reflecting one! In some of the most difficult *test objects*, such as the feathers of a moth's wing, and the coloured scales of the diamond curculio; the minute ribs of the moth's feathers, and those of the scales of the diamond curculio, were defined with an accuracy of detail, which we in vain attempted to obtain with an excellent single microscope in our possession, made by the late scientific Mr. Samuel Varley; and, in the hair of a mouse, particularly where the usual microscopes can at most only show dark-coloured spots, longitudal wavy lines or furrows were most distinctly visible.

Mr. Cuthbert has, at present, only fitted up one of these compound microscopes, although he has finished the speculums for three. And it is his intention, shortly, to grind a concave speculum *of only three-tenths of an inch focus*, instead of six, as in the present microscope; and by which he will still more extend its magnifying powers, and add greatly to its value in aiding the pursuits of the naturalist, and the scientific enquirer into the minute wonders of the creation.

LXII.—*On a method of growing Pine-Apples under a Frame, with the heat of leaves alone. By Mr.* WILLIAM GIBSON, *gardener to* HENRY PETERS, *Esq., at Betchworth Castle, in Surrey.**

HE prepares his bed for his fruiting plants in February, with leaves collected in the autumn, chiefly of the common oak and Spanish chesnut. The frame he uses is thirteen feet long by six feet and a half wide, three feet and half high at the back, and two feet and a half high at the front. The basis of the bed is laid out eight feet wide, and this is gradually contracted to seven feet, when the bed has been raised to four feet and a half high. At this height the leaves are made level, and well trodden, after which a course of leaves ten inches thick is laid round the edge of the bed, in order to raise the bottom of the frame, which, when placed, is by that means so elevated that a sufficient depth for large plants is secured within it. The pine plants are then introduced within the frame, and are plunged into decayed leaves, about three inches above the rims of the pots. The advantages resulting from this deep immersion of the pots is, that the plants soon throw out roots among the leaves, which promotes the growth of the fruit, and as they then require much less water than is usually given to pine plants sunk in tan, *the fruit has, consequently, a higher flavour.*

It is advisable to make up a fresh bed for the plants, which are to be kept through the winter; but if leaves are not in abundance, a sufficient heat can be maintained in the old bed, by the aid of linings, to preserve the plants till the spring.

The succession plants are kept by Mr. Gibson in a similar bed of leaves, but the pots in which they are placed are sunk in tan, though not so as to cover their rims; because it is desirable not to let the roots of these plants extend beyond the pots.

* From vol. V. of the Transactions of the London Horticultural Society.

THE

TECHNICAL REPOSITORY.

LXIII.—*Specification of the Patent granted to* CHARLES PHILLIPS, *of Upnor, in the parish of Findsbury, in the county of Kent, esquire; for a certain improvement or improvements in the construction of a Ship's Compass.* Patent dated June 15, 1825.

WITH A PLATE.

I THE said Charles Phillips do hereby declare, that the nature of my said invention and how the same may be performed, is herein set forth and explained, by the following description and drawings hereto annexed, (that is to say); —in plate X. fig. 1 represents a front elevation of one of my improved compasses, one side of the box or case in which it is fixed being removed that its peculiar construction may be seen more plainly. A, is a hollow tube, forming a standard, to support the compass; B, C, is a spiral spring which is contained within the tube or standard, and rests upon the moveable bearing, *a*; *b b*, are two handles attached to the bearing, *a*, by which it and the spring, C, may be elevated within the standard, A, and made to rest in either of the recesses, seen at 1, 2, 3, 4; *c*, is a groove or aperture, pierced in the tube or standard, A, and connected with the recesses 1, 2, 3, 4; a similar groove is formed on the opposite side of the standard, within which the other handle of the bearing, *a*, moves. Fig. 2 represents a vertical section through the centre of fig. 1.

A, A, is the hollow tube or standard, and B, the compass; C shows the the spiral spring, resting upon the moveable bearing, *a*; *d*, is a moveable portion of the standard; this

is cylindrical, and made to fit the internal bore of the tube A. A portion of the cylinder is reduced at *e*, in order to prevent friction, it being necessary that the part *d* should move up or down very freely within the tube A. *f* is a cap, fixed upon the standard, A, by a bayonet joint; this cap prevents the spring, C, from forcing the cylinder, *d*, out of the tube, A. *g* is the pivot that carries the compass card, D; the lower end of the pivot has a spherical ball, as shown at *h*, which rests upon a surface of cornelian, agate, or any other hard stone, let into the top of the cylinder, as seen at *i*, and it is confined in that state by the cap E, the upper internal part of the cap being made hemispherical, so as to form a portion of a cup, to cover the ball *h*, and permit it to move universally.

The lower internal part of the cap E screws on the upper end of the standard *d*; the lower portion of the pivot *g* is made slightly conical, and fits in a hole, formed in the crop bars F F, where is is retained by friction.

Fig. 1, G is a ring of lead, circumscribing the case of the compass, B; H is a guide, attached to the compass by sockets and screws, at *l l*; this guide goes through the leaden ring, and also through the brass piece, I I, let into the ring; a similar guide, and also the other parts described, are attached to the case on the opposite side; K K, are two handles, fastened to the leaden ring G, by which means it can be lifted up or down at pleasure, and it may be retained at any convenient height by the palls, L L, dropping into the notches of the racks, *m m*; which racks are screwed to the sides of the case B.

Fig. 3 represents an elevation of the upper and moveable part of the standard *d*, detached from the tube in which it moves. This figure is drawn of the real size and form, as it is made for compasses of the largest dimensions; and the cap, E, is shown in section, in order that the spherical ball, N, resting upon its agate bearing, *i*, may be better seen.

Fig. 4 shows a plan of the ring G; the recesses, *n n*,

receive the racks, *n n*, and the grooves or recesses, *o*, *o*, permit the guides, B, fig. 1, to pass freely through them.

M, fig. 2, represents a side view of the lubber's point, suspended and moving upon the centre, N; the centre N is placed between two guides, and may be raised or lowered at pleasure, being retained by a spring, fixed to the moving centre, N, which takes its bearing against one of the guides; (a front view of this, will be seen in fig. 5). *o*, is a pendulum bob, placed upon the stem of the lubber's point, which may be moved any where upon the stem, and it may be retained in any situation, by a spring contained within the bob.—This is to be adjusted so that the lubber's point, M, on the top, will be even with the upper edge of the compass; which may be done by raising or lowering the point of suspension, N, between the guides, until the desired adjustment is effected. The brass bob, *o*, should be shifted on the stem, until its centre agrees with the centre of the leaden ring, by which means the lubber's point will correspond with those of the compass.

Having enumerated the various parts, and shown how they are constructed and combined, I shall now endeavour to explain the peculiar advatages that result from the improvements I have invtened.

In fig. 2 the upper part of the standard, *d*, is seen resting upon the top of the spiral spring C, therefore, when the firing of cannon, or any other circumstances produce violent concussions, such as the sudden jerks produced by the paddles of a steam-boat, &c., the spiral spring will yield, and permit the compass to descend gently, which will effectually prevent the card from being unshipped, or thrown off its pivot, by any jar, however violent. In fine weather, the spiral spring, C, should be raised by the handles, *b b*, fig. 1, until the compass receives the full effect of the spiral spring; this will prevent any injury from a sudden blow or concussion, and it will also keep the compass card always sensible.

Should the motion of the compass box or case, be too

great in a vertical direction, the spiral spring must be regulated to suit it, by removing the handles, *b b*, up or down, and placing them in either of the notches, 1, 2, 3, 4, till the requisite motion is obtained.

To regulate the pendulous motion of the compass box, to suit the changes of the weather, the leaden ring, G, must be raised or lowered by the handles, K, K, as circumstances may require; whenever it blows hard, the leaden ring must be raised to such a height as to reduce the motion to that degree which shall be most convenient; for instance, when the weather is bad, the leaden ring, G, must be raised as high as the racks, *m m*, on each side will permit; and in fine weather, on the contrary, as low as it will allow: thus the pendulous motion of the compass may be adjusted to suit the circumstances of the weather in any case, and the palls, L L, will drop into the teeth of the racks, and retain it there.

For I shall here observe, the intention of the leaden ring is to form an adjustable weight, by which the centre of gravity of the compass box may either be raised or lowered at pleasure. By this simple contrivance, the motion of the compass box upon its spherical bearing, may be equallized in all weather.

But in order to identify and distinguish my invention more clearly, I hereby declare that it consists,

Firstly, in suspending or supporting a ship's compass, upon bearings connected or combined with an elastic spring or springs, by the application of which, in the way I have described, the unpleasant effects that have hitherto been experienced from sudden blows or concussions will be completely avoided; and, consequently, the compass card will be more secure from being thrown off the pivot, than by any of the methods hitherto known or made use of by the public.

Secondly, I claim also the application of a moveable ring or weight to a ship's compass, united to the other adjusting appendages explained in the drawing; which, being

combined and applied in the way I have described, will enable any person to regulate the pendulous motion of a ship's compass, and thereby produce a greater degree of sensibility in that instrument than was ever before known or made use of.

And I shall here further observe, that, although I prefer the method of supporting the moveable weight, G, by means of racks and palls, as shown in the drawings, yet the same may be suspended from the case of the compass by three chains, the links of which may be placed upon hooks fixed in the case, or by a variety of means known to workmen, without departing from the principle contained in my invention; namely, that of suspending or supporting ship's compasses upon elastic springs, by which means the effects of concussions will be avoided. And also by applying a moveable weight to the cases of compasses, they may be rendered more sensible than by any means hitherto known or made use of.

And, thirdly, I claim the right of making the suspending point, or centre of a lubber's point, moveable; and also of making the pendulous bob moveable; by which means an adjustment may be obtained that will, at all times, coincide with the motion of the compass.

On applying to Messrs. Bramah's, the Editor was favoured with the following particulars by Mr. Francis Bramah.

DEAR SIR, *Pimlico, Oct. 18th*, 1825.

I am not aware that we can give you any further information on Captain Phillips's compass than what you will gain from the specification of it, and the following directions for using it; excepting that an experiment was ordered to be made some time ago on board the Phæton frigate, and it answered every expectation. A particular advantage it appeared to possess in this trial, over the common compass, was, that on broadsides being fired, the card was in no way disturbed; whilst the card of the usual or common compass was,

on every discharge of the guns, thrown from its point to the bottom of the case.

We are the sole manufacturers for the patentee, and several have been lately made for the Navy Board, and sent to different stations; and I hope, eventually, that they will be generally adopted throughout the navy.

I remain, dear sir, yours, &c.

To THOMAS GILL, *Esq.* FRANCIS BRAMAH.

Directions for the use of Captain Charles Phillips', R.N. Improved Compass.

To regulate the motion of the compass box, to suit the changes of the weather, the leaden ring must be raised or lowered by the handles, as circumstances require it; whenever it blows hard, the leaden ring must be raised to such a height as to reduce the motion to that which the person who uses it may require; for instance, when the weather is bad, the leaden ring must be raised as high as the rack will admit, and in fine weather, on the contrary, as low as it will allow, thus regulating the motion to its required quantity.

In fine weather the spiral spring should be raised by the other handles, until the compass receives the full effect of the spring, which will prevent any concussion from a sudden blow, and will also keep the compass card always sensible.

In bad weather, if the motion of the compass box is too great in a vertical direction, the spring must be regulated to suit it, by removing the latter handles up or down, till the requisite motion is obtained.

The pendulum is to be adjusted so that the lubber's point on the top will be even with the upper edge of the compass, which is done by raising or lowering the point of suspension between the guides, and the brass bob to be shifted on the rod, until its centre agrees with the centre of the leaden ring, by which the vibrations of the lubber's point will correspond with those of the compass.

LXIV.—*Specification of the Patent granted to* JOSEPH MANTON, *of Hanover-square, in the parish of Saint George, Hanover-square, in the county of Middlesex, gun-maker; for a certain improvement in Shot.* Dated March 25, 1825.

I, THE said Joseph Manton, do hereby declare, that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained as follows: (that is to say) my said invention of a certain improvement in shot, is applicable to the lead shot, commonly used in fowling-pieces for killing game and other purposes, and consists in coating the surface of the shot with the metal called mercury, or quicksilver, whereby it is rendered white, much more convenient for use, more cleanly, and not so liable to injure the quality of the game killed by it, as when prepared in the usual manner, nor to adhere to the barrels of fowling-pieces; and I hereby claim as my invention any and every mode by which lead shot may be coated with mercury or quicksilver. As, however, it is desirable that I should afford an example of a method or methods of carrying my said invention into effect, I shall proceed to do so as follows. I take the lead shot, in preference, before it is glazed with plumbago or black lead, and put it into a vessel either of a globular or barrel shape, which can be closed, and which I prefer to be made of iron, and capable of receiving either a revolving movement on an axis, or of being agitated backwards and forwards, or in any other fit and proper manner. Into this vessel or vessels, I put about one hundred pounds weight of lead shot and about one pound of mercury or quicksilver, and nearly fill it with water; I then briskly stir or agitate the whole together, until I find, on trial, that the whole of the mercury or quicksilver has spread and diffused itself uniformly, and coated the surface of the shot; after which I wash it well in water. I then spread the shot upon a

cloth or canvas, which is stretched on a frame of wood and rub the shot with a sponge or cloth, which will make it dry quicker. Should the shot lose its silvery colour by being kept a long time, it may be restored by again putting it into a revolving vessel, or one capable of being shaken or agitated, together with some water, and a little mercury or quicksilver, and be treated as before mentioned.

Note.—We have seen specimens of this improved shot, and which fully appear to us to justify the encomiums passed upon it in the above specification.

Mr. Manton has also lately patented an improvement on percussion guns, which will, no doubt, increase the high reputation he already enjoys as a gun-maker.

LXV.—*On rendering Gravers capable of Engraving Steel-Plates. By Mr.* EDMUND TURRELL.

No. 46, Clarendon-street, Somers-town,
October 15, 1825.

DEAR SIR,

As you have already published, in your *Technical Repository*, my *menstruum for etching steel-plates*,* I think it desirable that you should likewise add thereto a method which necessity, the mother of invention, compelled me to adopt, of improving the quality of gravers, so as to render them capable of engraving steel-plates; and which may, possibly, also be applicable to many other useful purposes in improving the edges of cutting instruments.

My writing engraver was under the necessity of informing me, some time since, that he should be obliged to give up the task of engraving upon steel plates, owing to the impossibility of finding any gravers capable of cutting them, without the almost endless repetition of their points breaking. This put me upon the necessity of employing all those resources which opportunity had furnished me with the means of acquiring, in improving the quality of gravers;

* See Vol. VII. page 105.

and, luckily, I hit upon the following simple and effectual method of accomplishing my object.

I had formerly been much in the habit of seeing the singular manner in which the watch-spring makers, in Clerkenwell, treat the steel their springs are made of. They are made of steel-wire, of a proper quality, and of various diameters, according to the breadth and thickness of the springs to be made thereof, and are spread by the hammer, when cold, into the thin plates forming the springs. After being brought to a certain thinness and width, they are hardened, and then tempered, over the flame of a spirit lamp, to the spring temper, or, as it is termed, the raven's grey colour; they are then subjected to the *planishing and condensing* action of the hammer, to bring them to the proper degree of thinness and breadth to form the springs; and being then brightened, by a method which it is unnecessary to describe here, but which may probably furnish part of an article I have in contemplation to supply you with, on the manufacture of these highly important articles; they are, lastly, *blued*, over the flame of a spirit lamp.

Now, previous to their being *blued*, they had, by the planishing, condensing, and polishing, apparently lost all their elasticity and hardness, and could be readily bent in any manner, and would afterwards remain so bent, as though they had never been hardened and tempered at all; and yet, upon being *blued*, they regained all that *elasticity* for which they are so highly esteemed.

Considering the above facts, I thought that, upon *tempering a graver*, though not to the degree used by the watch-spring makers, it might possibly be rendered capable of being acted upon by the blows of a hammer, so as *to condense the pores of the steel, opened, as they inevitably must be, by the heat necessary in even the most careful hardening*; but still more so in the usual manner of making gravers in great numbers; and, accordingly, *I tempered a graver to the straw-colour only*, and had the satisfaction

to find that, on laying the back of it upon a rounded anvil, I could, by the repetition of gentle blows, with the flat cross-pane of a small and very hard cast-steel watch-maker's hammer, succeed in *rounding* or *blunting* the *acute edge* of the belly of it considerably; thus proving that *it had undergone a great degree of condensation;* and upon again tempering it to a *straw-colour*, and grinding and whetting the edge to its proper shape, *the graver readily cut the steel-plate*, and continued to do so, it being evidently also much *toughened* by this additional labour.

I have since repeatedly succeeded in thus improving the quality of those Lancashire or Sheffield gravers which are to be met with in the tool shops; and with such gravers my writing engraver has now much less difficulty in performing his work on steel-plates than before.

It must be evident to any person who reflects on the general methods of treating steel, that *the more it is condensed by hammering*, the more will the attraction of cohesion between its particles be encreased; and, consequently, the *toughness* of the metal be also greatly promoted. To effect this desirable object, many persons hammer their steel articles, when cold, for a considerable time before heating them, to harden them by quenching in a suitable fluid; but, unfortunately, the very operation of heating them must, of necessity, in a considerable degree, destroy the good effects produced by the previous cold hammering upon them, and thereby prevent, in a great measure, the advantages contemplated. But, by adopting the method described above, and the value of which I have verified by considerable experience, advantage may be taken of every improvement that has hitherto been practised in the art of making gravers, while *additional and most valuable qualities* may be given to them, and by means extremely simple, and easily applied by every engraver to his own tools.

I am happy to add, that this method of treating or improving the quality of gravers, has also been applied by one of our first mechanics, Mr. P. Keir, to turning tools;

and which were found to stand their work much better than when simply hardened and reduced by tempering in the usual manner to a straw-colour.

Should these observations be deemed worthy of a place in your valuable work, I shall feel much gratified in laying before the public, through its means, the result of my experience.

I am, dear sir, yours very sincerely,

To T. GILL, *Esq.* EDMUND TURRELL.

Observations by the EDITOR.

This process of Mr. Turrell's of *hammer-hardening* his gravers on their angular edges *cold*, valuable as it undoubtedly is, may, nevertheless, admit of improvement. *If the gravers were to be heated to the tempering degree, at the time of hammering them, the condensing effect of the hammer would be much greater*; and no possible harm could result from that degree of heat being *then* employed; a heat, indeed, to which he himself subjects them, both before and after hammering them.

Our readers will find the Editor's process for making gravers and etching needles described in vol. VII. of this work, page 241; they were sufficiently *dense* for engraving on *copper*-plates; but for *steel-plates*, no doubt the *closing the pores of the steel, after hardening them* in the above manner, would be an improvement.

We have described the mode of *setting steel articles straight*, which have warped by hardening, *by heating them to the tempering heat at the time of setting them*, in our articles "*on iron and steel*," in vol. I. page 214, to which we must refer our readers; only observing, that the steel is, *when so heated*, much more *yielding*, and susceptible of receiving the impression of the hammer than when it is *cold*.

The Editor has suggested to Mr. Turrell the advantage of hammering his gravers at the tempering heat, and he intends to adopt that practice on the next occasion.

Mr. Jacob Perkins, on being informed by the Editor of Mr. Turrell's great improvement in his gravers, and of the above suggestion of hammering them while hot, immediately stated that he had recommended an edge-tool maker, in the United States, twenty years since, to *hammer harden his axes, &c. at the tempering heat, and to continue hammering them till cold;* and which practice he adopted, and made a fortune from the great estimation in which his tools were held there. What is more curious, Mr. Perkins derived the hint of hammer-hardening from the very same practice that Mr. Turrell did; namely, from that of a watch-spring maker in America. One would naturally hence suppose, that Mr. Perkins had been informed by the Editor of the source from whence Mr. Turrell derived his idea; but this was impossible, as it was mentioned to the Editor by Mr. Perkins, before he informed him of the coincidence of their ideas! We had before known of Mr. Perkins's great experience in the difficult art of treating steel, from the admirable processes employed by him in his Siderography*.

In slender articles, like the graver for instance, where they may cool too soon, or before they have sustained the full action of hammering, it may be well to brighten them partially, by rubbing them with a piece of coarse grit-stone, and again to submit them to the tempering heat, and hammer them while hot; and so proceed repeatedly, until they are sufficiently condensed.

Mr. Turrell finds that, after hammering his gravers a certain time, they yield a sharp ringing sound to the blows, very different to that which they afforded on his beginning to hammer them; and that after perceiving that sound, he does not find that the hammer exercises any further action upon them, in condensing them; possibly a renewal of the heat may promote their further condensation.

* See Vol. I, page 200.

LXVI.—*On the French Mode of treating Scythes, by hammering them Cold.*

WE happened to mention *Mr. Turrell's great improvement in gravers* to our worthy correspondent who furnished us with the notice on the French method of treating scythes, described in our third volume, page 63, viz. by placing the scythe *flatways* upon a portable anvil, fixed in the head of a stake driven into the earth, and hammering its edge dexterously all along it with gentle strokes of a hammer, and he immediately noticed the very great analogy in the two methods, though applied in a different manner, and to very different purposes; *and Mr. Turrell's great success in the improvement of that highly important implement, the graver,* fully warrants us in the conclusion, that *the scythe must likewise be greatly improved by the condensing effect of the blows of the hammer upon the flat sides of its edge.* Thus the one improvement throws an additional light upon the other; and we shall gladly learn the success of the application of this valuable practice of *hammer-hardening in the cold,* after the usual hardening and tempering processes, to such objects as it may, and no doubt will, now be very shortly employed upon.

LXVII.—*On the advantages of improving the qualities of Cutting Instruments, by Burnishing, and thereby condensing their Edges. By the* EDITOR.

THE *condensing process* of *hammer-hardening* the edges of cutting instruments, such as the graver and scythe, has naturally led us to consider the action of the burnisher upon the edges of other cutting instruments in a similar light, and to infer that a great part of the benefit derived therefrom, must be owing to *its condensing effect,* as well also to its giving the edges a greater degree of smoothness, and in some cases a more favourable position for effecting the different purposes they are applied to.

The currier's shaving knife is the first instance we shall quote, where, after renewing its edge, by whetting it upon the proper whet-stone, as well as continually during its use, *the edge is always burnished.*

The next, and a familiar example, is in the *steel scraper* used by the cabinet makers, to smoothen the surface of hard wood, after the toothed plane, previous to varnishing or polishing of it.* When the edge of this hardened and tempered flat piece of sheet steel becomes dull, it is renovated by placing it upright, and whetting it upon the oil-stone; it is then whetted upon each side, to remove the burs; and, lastly, *burnished upon the face of it, towards each side, so as to throw the edges outwards.* It is held in *a sloping direction* in use, exactly as a piece of broken window-glass is held, when used as a shave, for which, however, it is an admirable substitute, as it performs its work in a similar, though much more perfect manner.

The next example is furnished from the practice of a late ingenious mathematical instrument maker, Mr. R. Fidler, who was continually employed by the late Mr. W. Lowry, the celebrated engraver, when he had any instruments to be made, for his business of mechanical engraving, which required particular accuracy in their construction. He was in the habit of *finishing his turning tools for brass,* after forming them into shape, and whetting them, *by burnishing their edges from their sides towards their flat faces,* and thus giving them *a hardness and smoothness* not to be acquired in any other way; and, in fact, *they polished* the brass-work turned by them.

The last instance is borrowed from the practice of a late eminent mechanic in the country. He was employed to make some *hardened and tempered steel cutters* for an engine, and which were to be driven with great velocity by a steam-engine, at Manchester, for a cotton mill there;

* See vol. I. page 256.

to cut brass toothed wheels and pinions, they requiring to be cut, rounded-off, and polished, at once!

After properly shaping them, (which shape, however, we shall not describe here, as it deserves to form an article of itself), and *skive-grinding* the faces of their teeth, he finished them by *burnishing their edges forwards, from their sides to their flat faces,* and their effects *in cutting and polishing the teeth at once, were truly wonderful.*

LXVIII.—*On renewing White-Thorn Hedges from their Roots.* By MR. JOHN FAREY, *sen.*

SIR. *No. 44, Lincoln's Inn Fields, Oct. 2, 1825.*

OBSERVING the subject of raising fences from the cuttings of the roots of the white-thorn to be under discussion in your useful pages, I beg the favour to ask, as nearly as you may be able to recollect or ascertain, *the date when* this mode was practised in fencing the old Birmingham canal; and *by whom* it was done, or directed; and I beg to mention, that Mr. George Toplis, of Brassington, in Derbyshire, for several years, prior to 1808, practised this mode of planting *root-cuttings,* as I have mentioned in page 86, of my report on Derbyshire, Vol. II; and where I also allude to my successful practice at Woburn, 30 years ago, in renovating worn-out or mismanaged white-thorn hedges, by *cutting them down, below the forkings of the stems, to to form roots, and thereby separating their roots as so many distinct plants, which grew up with the greatest vigour, and soon formed thick and close hedges.*

I am, sir, your obedient servant,

To THOMAS GILL, *Esq.* JOHN FAREY

We are unable to furnish the particulars requested by Mr. Farey. The practice must, however, have been long antecedent to the period mentioned by him. We think the above method practiced by Mr. Farey, must be effectual, in many cases, and is well deserving of adoption.

LXIX.—*On the Propagation of other Trees and Plants, besides the White-thorn, from cuttings of their Roots. By the late* SAMUEL TAYLOR, *Esq. of Moston, near Manchester.*

ON a visit made by the Editor to Mr. Taylor, in the latter end of the year 1806, he found him doing this, as follows: The cuttings of the roots were about two inches long, and the thickness of a quill, or even less, they were plunged; nearly their whole length, into moistened *sand,** contained in a broad shallow earthen pan, covered with a low hand-glass, and were kept in his conservatory. He pulled one of them up, and showed the Editor a swelling which had formed around the lower part of it, from whence he said the fibres of the root would afterwards shoot out.

We apprehend that it is only some particular kinds of plants which are susceptible of being propagated by this means; it is, however, well worth the while to ascertain this by experiment.

LXX.—*On the use of Sand in Propagating Trees, Shrubs, and Plants, from cuttings of them. By Mr.* THOMAS HAYNES, *of Oundle, Northamptonshire.*†

"*THE finest white sand is superlatively useful to autumn-planted cuttings of the more tender evergreen trees and shrubs.* In the business of planting cuttings of these under hand-glasses, in the autumn, as well as the more hardy green-house plants, such as myrtles, faschia, roses, cistuses, germander, &c. no unmixed soil whatever can be found to bear a comparison with the *finest white sand*; as cuttings planted therein will be far more secure from mouldiness throughout the autumnal and winter seasons; during which times, the pots in which they are planted,

* See the following article.

† From his "Essay on Soils and Composts." 1821.

generally remain standing up to their rims in the common ground, as the greatest preservative from frost; but in which situation, they are more exposed to the ill effects of damp, than if standing on the surface.

"Although but little more than a knot, or a swelling protuberance, at the foot of each cutting, can be effected, during the first autumn; yet, on the advance of spring, they will early make roots, even without the addition of any other soil or article to promote their growth; and which young plants, being potted off, or transplanted in some way, as soon as they have formed sufficient roots; immense *quantities, from these small cuttings, may thus be annually propagated,* by the help of full sized single hand-glasses! This process, however, will not extend to any other description of plants than the evergreens.

"In the propagation of the trees and shrubs alluded to by this process, it must be recollected, that the sand is to be considered as no farther essential, than to strike or promote growth in the cuttings, sufficient for transplantation; as, on their being removed into another situation, in the next stage of the process, a mixture of suitable soil, with a proportion of sand only, will be requisite.

"We are not asserting that *yellow-sand* will not equally apply in both cases, of planting cuttings of hardy evergreen trees and shrubs, both by summer-planting, in the open exposure, and autumn planting, under hand-glasses; but in all the experiments we have witnessed, and throughout the whole of our own practice, *white-sand,* where it could be obtained, has been invariably applied, and most successfully.

"When we reflect, that *mouldiness* is the chief annoyance to cuttings of almost every description, when planted under hand-glasses; every propagator should strenuously guard against it: and we know of nothing *so likely to discharge wet, and prevent undue retention of moisture, as sand alone;* and this, in preference to every other soil and compost.

"There are few soils with which sand cannot be intermingled to the greatest advantage in various other branches of horticulture, as well as in the propagation of plants and flowers; it being admirably adapted, from its loose and open nature, to expand the pores of heavier, more close, and adhesive soils, thereby opening the entire mass of compost, and rendering it porous, and open to the free admission, and full expansion of the delicately fine, and thread-like roots of plants and flowers; and in which we have most satisfactorily witnessed its singular and superior efficacy! We have known in various cases, plants to have been placed in soils most opposite and ungenial to their natures and constitutions, and thereby early inclining to decay; but which were speedily restored to their original vigour and complexion, by a proper and timely application of white-sand.

"The sand which has invariably been found to surpass all others for general and special purposes in horticulture, is *a peculiarly soft and fine white-sand, of an unusual smoothness, nearly as fine as flour-emery.*

"Where none other than the common white sand, which is usually coarse, can be obtained, small quantities of the most fine can be sifted out with a fine sieve*.

"Little argument can be necessary to convince the unprejudiced florist, gardener, or amateur, of the general utility of suitable sands being mixed with the more cold and heavier soils; thereby rendering them open and porous to discharge all copious falls of rain, dissolving snow, &c.; and which tend to overcharge adhesive soils with an undue proportion of moisture, and thereby to chill and starve the stock of plants and flowers."

* Or still better procured from it by washing over. Editor.

LXXI.—*On the Blowing of Air into Furnaces by a Fall of Water. By the late celebrated* WILLIAM LEWIS, *M.D.*

(Continued from page 203.)

THE force of the air may be determined in an easier and more simple method, by means of a glass pipe, open at both ends, with one end fixed in a bason of water. The bason may be hung in the upper part of the tub, or air-vessel of our water machines, and the glass pipe let into it, through a hole in the top; what space may remain between the pipe and the hole being properly closed: the pressure of the air upon the surface of the fluid in the bason forces part of it up into the pipe; and this ascent will always be the measure of the power or density of the air. Water is here greatly preferable to the quicksilver, used in the same intention on other occasions, as it discovers smaller variations in the force; for, being fourteen times less ponderous than quicksilver, an equal pressure forces it fourteen times higher in the pipe: the whole ascent of quicksilver, by the pressure of the air in bellows, is so small as frequently not to exceed that part of the pipe which is inserted into the tub. Instead of a glass pipe, a copper or iron one may be used, and the ascent of the water measured, either by occasionally dipping a rod in it, or by means of a hollow copper ball, or other floating body, with a stem standing out of the pipe, and a proper weight below, to keep it upright. It must be observed, that the height of the water in the pipe is to be estimated from the surface of the water in the bason: whence the pipe ought to be of small bore, in proportion to the bason, that the water may not fall considerably in the bason, by the loss of that which rises in the pipe.

Dr. Halls found that a smith's bellows raised a mercurial gauge about an inch, so that it would have raised a water-gauge about fourteen inches. The twenty-five ounces and a half, raised in M. Barthès's experiment, by the blast of

the machine of St. Pierre, from an aperture of an inch and a quarter bore, English measure, are equivalent, to the ascent of water in the gauge-pipe, forty or forty-one inches. I have been informed that the pipe hy which the air is discharged into our iron furnaces, is, at least, of an inch and a half bore; and that the air, with this aperture to pass off by, ought to be of as great density as it can be reduced to by the human breath, in a confined space; which is such as to raise the water in the gauge about fifty inches; in which case it is compressed into near an eighth part less volume than it commonly occupies in the atmosphere. But the quality of the fuel, and other circumstances, occasion such variations in this respect, that no general standard can be laid down. I have been assured that a charcoal fire will be excited as strongly, by such a blast as raises the gauge thirty-six inches, as a fire of coaked pit-coal will be, by one of fifty inches.

II. *Observations on the air-vessel.*—The structure of the air-vessel, or tub at the bottom, is, in great measure, independent of that of the rest of the instrument; the same air-vessel serving equally for different kinds and sizes of these machines, while the perfection of the other parts consists in their adjustment and proportion to one another.

The office of this air-vessel being only to serve as a reservoir for the air, and to suffer the waste water to pass off, no great care seems to be needful for regulating its dimensions; and as the stone which is placed in it under the pipe, serves only to receive and support the fall of water, or to occasion the water to be dashed into small particles, that the air may be more effectually extricated, its distance from the pipe seems also to require no exact adjustment. There are, however, some particulars in regard to the size of this vessel, and the disposition of some of its parts, which appear to deserve attention.

The gauge mentioned in the preceding article, will be a useful addition to it; showing at all times, by inspection,

the force of the blast, and thus enabling the workman to judge whether it is sufficient for the purposes intended, and giving him notice of any failings that may have happened in the machine, as whether any air escapes through the joints, or a crack; or whether the choak, or throat of the funnel is obstructed by stones, or other matters brought by the stream.

All the writers I have met with, who give any account of this kind of blowing machines, seem to suppose the water within and without the air-vessel, to be upon a level. But as the air in the vessel is so far compressed as to be able to raite the water in the gauge to a considerable height, it must necessarily act with equal power on the water below it; and if this water can pass off freely at the bottom, it must be depressed as much as that in the gauge pipe is raised. The water within and without the vessel is exactly in the same situation with that in the bason and pipe of the guage, excepting only that the former receives a continual supply within, which passes off as fast on the outside. The excess of the height of water on the outside of the vessel, above that of the water within, appears to be the very power by which the air is compressed, and driven into the furnace.

To be further satisfied of this depression of the water, I used, for the air-vessel of a small machine, a tall glass, without a bottom; seven or eight inches of its lower part being immersed into a tub of water. As soon as the machine began to play, and the gauge to rise, the water within the glass sunk lower than that in the tub on the outside; and the depression of the water, and rising of the gauge, were, as nearly as could be judged, equal, and kept pace with one another. In a little time the water was forced quite out of the glass, and the air following it rose in bubbles to the top of the tub.

The bottom of the air-vessel ought, therefore, to be sunk, at least as much below the level where the external water passes off, as the gauge is expected to rise; for,

otherwise, before the air is sufficiently compressed, to raise the gauge to the due height, it will force all the water out below, and in part escape itself by the same aperture. Hence, the depth of the air-vessel, in any of these machines where the water has a free passage at the bottom, gives a power which the force of the blast in that machine can never be made to exceed; thus, at Leadhills, the water being only of the height of two feet from the bottom of the vessel to the level of the bank where it runs off, the air can never be compressed further than to be able to support a column of two feet of water, or to raise the gauge to that height; whereas, in the machine of St. Pierre, the compressure is about two-thirds greater.

The sinking of the water in the air vessel may, indeed, be prevented, by making the aperture in the bottom, through which the water is discharged, of such a size that the pressure of the air may be able to drive through it no more water than is received at the top. But such an adjustment would be, apparently, very difficult; and though it should be exactly hit, yet, if the quantity of water received was not always the same, it would scarcely be possible to avoid, either a depression or elevation of the water in the air-vessel.

Though the depth of water be sufficient to resist the pressure of the air, it will be easily conceived, that if there were no solid body to support the fall, the great force of the stream, falling from such a height, would push down, or dash about, great part of the water in the bottom, so that the air would get at the hole, and, in part, make its escape with the water. It may be presumed, that even the drops of water rebounding from the stone, and falling down again, have a like effect, though in a lesser degree; for drops falling through the common atmosphere into water, carry air with them, which afterwards rises in bubbles, as may be observed in heavy rains; and it is not to be supposed that the drops should not here also carry into the water some of the compressed

air which surrounds them, and is entangled between them. Though part of the air which thus passes into the water doubtless rises again in bubbles, as appeared in using the glass vessel above-mentioned, yet part may also be pushed so low, as to escape through the hole, and discover itself by bubbles in the water on the outside of the vessel, and which I several times observed before the water was driven entirely out of the glass.

M. Barthès likewise takes notice of air being either thus carried down into the water by the drops, or introduced into the cavities which they form in falling. In order to prevent it, he recommends making a partition across the tub at the level of the stone, with only a hole at one side, and this in the part most remote from the pipe through which the water falls; the rebounding drops are received upon the board, and run off gently through the hole in the water underneath.

The inconvenience may be prevented also, as effectually, and with more advantage in other respects, by making the air vessel of a very considerable depth, below the surface of the stone; it may be sunk several feet into the ground, below the level of where the outward water runs off, so as to always have a column of water in the vessel, of any height required, or of a height which shall prevent any air from passing down to the bottom. This structure would free the workman from any care about increasing or diminishing the aperture, or regulating the height of the water; for, if the deep vessel has an aperture in its lower part, large enough to discharge all the water that can fall into it through the pipe in the top, or, for the greater security, a great deal larger, its magnitude being of no inconvenience; if this vessel is sunk into a pit of water, up to the level of the stone, or to a certain height above it, and if the pit has a drain sufficient to carry off what more water it may receive, we may be sure that the water will be always high enough in the vessel, because the pressure of the water on the outside will keep it so,

and that the pressure of the air within the vessel will always keep it below the surface of the stone.

The air extricated from the water is always moist;* when let off at a little way above the stone, I have often observed it to have drops like dew on any solid body opposed to it.

The joints should be well secured, to prevent the escape of any air through them: the stone for receiving the dash of water, should be placed as much below the level of where the water runs off, as the gauge is expected to rise, and the pipe should reach as low as within five or six inches of the stone. It would, perhaps, be of some advantage, to have the surface of the stone a little concave, so as to occasion the watery drops to be rather dashed backwards towards the stream, than thrown upwards, through the cavity of the vessel.

III.—*Experiments of Air passing down through Pipes, with falling Water.*

Water running through a Crane.—In the running of water through a siphon, or common crane, when the sucking-pipe on the longer leg of the crane was stopped up, the water, as it issued from the extremity, filled the bore; on opening the sucking-pipe, the column of water appeared less than the bore.

Judging that the motion of the water must be retarded in this last circumstance, I measured, by a pendulum, the times in which equal quantities of water run through the crane in both cases, and found, in many trials, that the quantity which took the time of a hundred swings of the pendulum to run in when the sucking-pipe was open, ran in ninety-three, and sometimes ninety-two, when it was stopped.

As these differences seemed to proceed from air intro-

* Hence its superior value for exciting the fires of forges, steam-engine boilers, &c.; and Mr. Nicholson endeavoured to increase its *moistness*, by the admixture of *steam* with it. Editor.

duced into the water through the lateral pipe, I tried to make the air sensible, by raising the vessel which received the water from the crane, and keeping the nose of the crane immersed in it. As often as the sucking-pipe was opened, air-bubbles arose in the water of the receiver, and fresh bubbles succeeded while it continued open; but so long as it was kept stopped no air bubbles were seen.

To collect the air, a cask without a bottom was sunk nine or ten inches in a tub of water, and the nose of the crane inserted into a hole made in the top of the cask: into another hole in the top was fitted a small pipe for giving vent to the air, and within the cask was fixed an inverted mortar, for the stream to fall on. So long as water was kept running through the crane, with the sucking-pipe open, a sensible blast issued from the blowing-pipe of the cask, and a burning coal exposed to it was excited in the same manner as by a common bellows; the sucking-pipe being stopped, no blast was perceived, nor was any motion produced in the flame of a candle applied to the orifice.

It appears, therefore, that water, running through an upright pipe, and filling its bore, admits air to enter through a lateral pipe; that, after this admission, the width of the column of water contracts the introduced air occupying part of the cavity of the pipe, and that this air passes down on the outside of the water, or in a separate column, not intermixed with it, so as to render it frothy.

(To be continued.)

LXXII.—*On the manufacture of Red-chalk Crayons.*

THE red-chalk crayon and its uses are too well known in daily life, to require anything to be said of them. The preparation of those red crayons which are best adapted for drawing, however, is less known. The following is the manner in which it is performed: A quantity of *hematite* is ground in a porphyry mortar, with filtered water, until

it be extremely divided, so as to form an impalpable powder. This powder is again diffused in a quantity of water sufficient to allow finer parts of the mixture to be passed through a fine sieve, placed above a large vessel filled with water. The liquid holding the hamitite in suspension, is then agitated*; and after this, allowed to rest four and twenty hours. At the end of this time, there is formed at the bottom of the vessel a deposit of hematite, in the form of a very fine powder: the water is cautiously decanted from it.

To form crayons of this impalpable powder, a uniting medium is necessary. This is afforded either by gum arabic or isinglass, of which the proportions vary, according to the use to which the crayon is destined; less of it being required for soft crayons, which, consequently, yield their colour more readily; and more for the hard ones, which preserve their points longer. The following are the proportions, reduced from experiments, to be employed in the five kinds of crayons, which we shall describe.

1. For the soft red crayons, which leave broad traces, 18 grains of dry gum arabic, to 1 ounce of the prepared hematite powder.

2. For harder crayons, 21 grains of gum, to 1 ounce of the hematite powder.

3. For still harder crayons, and which make small and delicate marks, 22 grains of gum to 1 ounce of hematite

4. For the hardest of this kind, 27 grains of gum to 1 ounce of hematite.

5. For crayons which leave shining traces, 36 grains of isinglass to 1 ounce of the prepared hematite powder.

The gum or isinglass is to be dissolved separately in a

*There seems to be an omission here, of the operation usually termed, "washing over;" that is, suffering the hematite, after stirring up the liquid, to remain suspended for a certain time, as half a minute, for instance, in order that the coarser parts of it may deposit themselves, and then pouring off the finer parts only, which remained in suspension, into another vessel, to remain to subside four and twenty hours, as directed. As otherwise, in so hard a body as the hematite, the powder would necessarily be a mixture of fine and coarse parts.---Editor.

sufficient quantity of water, and their solutions passed through a linen cloth; the hematite powder is then added. The liquid is brought near to a gentle fire, until the mass is somewhat thickened by the evaporation of the water, when it is to be removed from the fire. The mixture is then to be carefually ground on a porphyry slab, to render it as intimate as possible, and is ready to be formed into crayons. To effect this, the mass, when it has become of a proper conistence, is forced through a cylinder: the sticks thus formed, are dried, and divided into crayons of two inches long. They are then sharpened at their points; and the hard crust, which had formed upon them while drying, is removed.—*Newe Kunst et Gewerblat, Aug.* 1824.

LXXIII.—*Further observations on preventing the ravages of the Book-worm; and on rendering Copper-Plate Paper capable of bearing Writing Ink. By Mr.* THOMAS ALLSOP.

SIR, *Madras, May 4,* 1825.

THE first number of the VIIth volume of your valuable *Repository*, in which my communication "*on the properties of the margosa and rock oils*" is inserted, is now before me; and I hasten to add a slight omission which escaped me while writing the above, particularly from the circumstance of having heard that the latter oil is procurable in England; and as some of your readers may be anxious to ascertain the result of my experiments, I cannot but in justice to myself, as well as to the respectability of the *Technical Repository*, avoid noticing it.

In the last line of that number, page 17, after the word "with," add "*equal portions of the rock and margosa oils, &c.*" The margosa oil *alone*, is almost ineffective against the depredations of the *book-worm*, &c. although the leaves and flowers prevent their approach.*

* The rock oil alone is more effectual in these cases; but becomes a complete and lasting preventative, if mixed with the margosa oil, in equal proportions.

I hope I shall also be excused noticing another trifling omission, on the part of your ingenious and respectable engraver, Mr. Turrell, in having omitted the *letters of reference* to the Rev. Mr. Hitchcock's mineralogical hammer, in the copper-plate of the same number.—Vide article III. figs. 2, 3, and 4.

Although the letters of reference may be substituted by a steady hand with the pen, still they never can equal the neatness and uniformity of the engraver; and those persons unacquainted with the process of preventing the paper from sinking, might spoil the plate by attempting the correction therewith; as I believe it is found necessary to size all paper intended for *copper-plate printing*, and often for *letter-press* also, *but very slightly*, in order that it may receive a clear impression, the paper in such case yielding to the pressure with facility, and imbibing the ink with more ease and softness than if *strongly sized.* It may, therefore, be of some service to your readers if you could acquaint them with the best and safest method of rendering *sinking*, or even blotting paper, secure against *running.* The methods I generally adopt in writing, as well as in drawing is, first to wash the suspected paper over with a weak solution of alum, in common, but clear water; when, by holding the paper up to the light, I soon discover whether it be fit for immediate use, or if it requires to be fresh sized. If spots or marks appear, I make a stronger solution of alum, in a small tea-cup, to which I add about a dessert spoonfull of well boiled arrow-root, starch, or hair-powder; and, after mixing it well, apply it while lukewarm, with a clean soft sponge, very lightly, all over the paper. One application is generally found sufficient to answer the desired purpose, unless the paper be very bad indeed, when a second may be applied.

I have also found that *conjee-water*, from boiled rice, (saturated as above), answers the purpose equally as well; and *pencil drawings*, &c. merely dipped in simple *conjee-water*, defy the action of India-rubber in removing even

the *faintest line.* You may possibly be in possession of similar useful facts, the publication of which might be of great general benefit.*

Should you deem these hints of the least utility, you are at liberty to make what use of them you may think fit.—In the mean time,

I remain, sir, your obedient servant,

To T. GILL, *Esq.* THOMAS ALLSOP.

LXXIV.—*On a French Luting used in Propagating Fruit-trees, by Grafting them.*

THE best luting wherewithal to cover the newly grafted scions, is composed of equal quantities of train oil and rosin, prepared in the following manner:—First, melt the rosin in an earthen vessel, and then pour in the oil; mix them well; to be applied when cold, with a painter's brush. The composition is used in the north-west part of France (Bretagne) with general success. It has this advantage, that it never cracks, nor admits rain or wind to the grafts, which is the usual cause of their failing. It is more expeditiously put on than the common clay covering, and looks much neater; but what renders it more useful is, that the grafts covered with the composition seldom fail. Scions laid under earth, or steeped in water for a few days, grow better than those taken fresh from the parent tree. Grafting cherry or pear-trees should not be delayed later than St. Patrick's day.—From the New Monthly Magazine for September, 1825.

N. B. A somewhat similar composition will be found described in Vol. V. p. 50, of this Work.

* The corrections in copper-plate impressions are best made with India ink and a crow-quill pen.—EDITOR.

LXXV.—*On Grafting the Cactus, on the Cactus Triqueter. By* Mr. JOHN NAIRN, *gardener to* THOMAS FORBES REYNOLDS, *Esq., of Carshalton, Surrey.*

MR. NAIRN exhibited, at the meeting of the London Horticultural Society, on the 15th of May, 1824, a plant of the *Cactus Triqueter*, on which three other species of *Cactus*, viz. *Cactus Flagelliformis*, *Cactus Speciosus*, and *Cactus Speciosissimus*, had been grafted. The appearance of these different plants, thus united, was singular, and the elevation of their weak branches on the strong, upright stem of the plant into which they were worked, is advantageous in the display of their fine blossoms.

Mr. Nairn thus describes the operation of grafting, which may be performed any time between the months of March and September:—"I take a small part of the plant I propose to engraft, and attach it, by cutting away a slice of the fleshy part of the stock, taking off, also, from the piece to be attached, a small portion of the flesh, to secure its adhesion. The sap is so glutinous, that the piece will adhere without tying; but it is most adviseable to fasten it with bass; great care, however, must be taken not to bruize it, for such an injury would cause it to rot. An union will soon be formed, and the graft will grow freely," Mr. Nairn has observed, that *the pendant direction which the grafted Cactuses take, causes them to produce their blossoms, not only more abundantly, but earlier.* He recommends a compost, formed of five parts of rich garden loam, and one part of bog mould, as best suited to their growth. They should be placed in pots, in the green-house or conservatory, and be freely supplied with water during the summer, but kept moderately dry in the winter.

Cactus Pereskia answers equally well for an elevating stock, as the *Cactus Triqueter*.

LIST OF PATENTS FOR NEW INVENTIONS,

Which have passed the Great Seal since Sept. 29, 1825.

To William Duesbury, of Bonsall, in the county of Derby, colour manufacturer; for a mode of preparing or manufacturing a White, from the impure native sulphate of Barytes. Dated September 29, 1825.—To be specified in six months.

To John Martineau, the younger, of the City-road, in the county of Middlesex, engineer; and Henry William Smith, of Lawrence Pountney-place, in the city of London, esq.; who, in consequence of a communication made to them, by a certain foreigner residing abroad, are in possession of certain improvements in the manufacture of steel. Dated October 6, 1825.—In six months.

To Sir George Cayley, of Brompton, in the county of York, baronet; for a new Locomotive Apparatus. Dated Oct. 6, 1825.—In two months.

To James Shudi Broadwood, of Great Pulteney-street, Golden-square, in the parish of Saint James, in the county of Middlesex, piano-forte maker; for certain improvements in Small, or what are commonly called Square Piano Fortes. Dated Oct. 6, 1825.—In six months.

To Thomas Howard, of New Broad-street, in the city of London, merchant; for an Engine, which he intends to call or denominate a Vapour Engine, Dated Oct, 13, 1825.—In six months,

To Nathaniel Kimball, of New York, but now residing at Falcon-square, in the city of London, merchant; who, in consequence of a communication made to him by a certain foreigner, residing abroad, of an invention or process of converting Iron into Steel. Dated Oct. 13, 1825.—In six months.

To Benjamin Saunders, of Bromsgrove, in the county of Worcester, button manufacturer; for certain improvements in the constructing or making of Buttons. Dated Oct. 13, 1825.—In six months.

To Thomas Dwyer, of Lower Ridge-street, in the parish of Saint Audeon, in the county of the city of Dublin, sik manu-

facturer; for certain improvements in the manufacture of Buttons. Dated Oct. 13, 1825.—In six months.

To Joseph Clesild Daniell, of Stoke, in the county of Wilts, clothier; for certain improvements in machinery, applicable to the Weaving of Woollen Cloths. Dated Oct. 13, 1825.—In six months.

To Josiah Easton, of Heal Cottage, in the parish of Bradford, in the county of Somerset, esq.; for certain improvements in Locomotive or Steam Carriages; and also in the manner of constructing the Roads or Ways for the same to travel over. Dated Oct. 13, 1825.—In six months.

To William Hirst, and John Wood, both of Leeds, in the county of York, manufacturers; and John Rogerson, of Leeds, aforesaid, millwright; for certain improvements in Machinery for Raising and Dressing of Cloth. Dated Oct 21, 1825.—In six months.

To Ralph Stephen Pemberton, and John Morgan, of the parish of Lanelly, in the county of Carmarthen; for a consolidated or combined Drawing or Forcing Pump. Dated Oct. 21, 1825.—In two months.

To Goldsworthy Gurney, of Argyll-street, Hanover-square, in the county of Middlesex, Surgeon; for certain improvements in the Apparatus for raising or generating Steam. Dated Oct. 21, 1825.—In six months.

To Lemuel Wellman Wright, of Princes-street, Lambeth, in the county of Surrey, engineer; for a certain improvement or improvements in the construction of Steam Engines. Dated Oct. 21, 1825.—In six months.

To Henry Constantine Jennings, of Devonshire-street, Portland-place, in the county of Middlesex, practical chemist; for certain improvements in the process of Refining Sugar. Dated Oct. 22, 1825.—In six months.

THE

TECHNICAL REPOSITORY.

LXXVI.—*On an Improved Bolting-Mill, for Flour; invented by Messrs.* P. BLACKMORE *and* JAMES AYTON.

WITH A PLATE.

THE great advantages that have been experienced by using bolting-cloths for dressing flour, has rendered any improvement on the bolting-mill an object of great importance.

As bolting-mills are made at present, they differ very little from each other; and, from the simplicity of their construction, may be very briefly described. The principal parts consist of a reel, composed of an axis, with six spokes fixed in it at each end, equally distant from each other; upon the ends of these spokes, six wooden bars are fixed, parallel to the axis, forming a frame or reel, over which the bolting-cloth is drawn, and fixed at one end of the reel by a running string. The other end of the bolting-cloth has six loops fixed within side of it, which are slipped into notches, formed on the end of each of the wooden bars.

On the outside of the reel thus formed, six bars of beech wood (technically called *beaters*) are fixed to the frame or case, within which the reel revolves; these bars are placed at about two inches distance from the reel, and as each end has a screw-bolt tapped into it, which passes through a radial slit, made in the frame or case, they may be adjusted at any time, as occasion may require.

The bolting-cloth being properly fixed, the meal is admitted within the cloth, at the upper end, and a very rapid motion being communicated to the reel, the cloth, by the centrifugal force, is thrown out, and strikes against

the beaters, by which means the flour is made to pass through the interstices of the cloth, and is collected in bins in the usual way. When the bolting-cloth is first set to work, it permits the flour to pass very freely through it; but after it has been used for a considerable time, it loses a portion of its elasticity, and, consequently, the action is much slower. A very ingenious contrivance has been invented, by Mr. J. Ayton, a practical miller, in the county of Norfolk, (for which he has obtained a patent). This consists of a series of springs, combined with an universal joint; which, being applied to a common reel, and one end of the cloth being attached to the springs, by fixing the loops on hooks, formed on the end of each spring, the operation is facilitated in the proportion of nearly 50 per cent! Several judicious improvements have been also made in the construction of the bolting-mill, by Mr. James Ayton, and Mr. P. Blackmore, bolting-cloth maker, of Wandsworth, in Surrey; which equally deserve the attention of practical millers, on account of the great saving they are calculated to effect in the use of bolting-cloths.

In plate XI. fig. 1, A A represents the frame of an improved bolting-machine. The inclosing boards or doors are removed, that the internal parts may be more plainly seen. B B B B are the beaters, which are so combined that they can be adjusted instantaneously, even while the mill is at work.

Fig. 2 represents an end view of fig. 1. C is a flat plate or ring of iron, placed in a recess formed in the tail-board, and retained there by the four stays, *a a a a*. In this plate six eccentric grooves are formed, shown at *b b b b b b*, in these are seen six square headed bolts, *c c c c c c*. These bolts are tapped at the other end, and are screwed into the ends of the beaters, being previously passed through the eccentric grooves *b b b b b b*, and also through the six radial slits, made in the head and tail-boards of the machine, shown by dotted lines at *d d d d d d*.

Upon the edge of the iron plate or ring, teeth are formed, which gear into the pinion *e*, fixed on the end of the spindle *f*; the place and position of the spindle *f*, will be seen best in fig. 1; and as there is a similar iron plate fixed in the head board, a similar pinion is also fixed near the other end of the spindle *f*, near *g*, where it is made square, to receive a winch, by which it may be turned. Therefore, whenever the spindle *f* is turned in a proper direction, the pinions fixed to it, acting in the teeth of the iron plates or rings c, will cause them to turn partly round; and the eccentric grooves will act upon the bolts, screwed into the ends of the beaters, and expand or contract them, as occasion may require.

D is the iron axis, one inch and an eighth square, of a fan or winnow, similar in its form to the axis of a common reel, the power being applied to it in the same manner as in the case of a reel. Upon this are fixed the two maces, *h* and *i*; each of these have four arms fixed in them at right angles, as seen at *k k*. To these arms four pieces of Russia duck are fixed, two of which are shewn at *l l*; these act as fans, when the bolting-cloth is drawn over them, and the machine put in motion.

E is a rim, similar to those fixed to a common reel, over which the bolting-cloth is fixed, by a running string in the head leather. Three semi-circular arms, (four of which are seen at *m m m m*,) unite this rim to the mace *i*, and form a frame, over which a net may be fixed, that will serve to spread the meal uniformly over the internal surface of the bolting-cloth, and thereby equalize the action of all parts of the cloth, while the winnow keeps the air in brisk motion, which greatly assists in forcing the flour through the meshes of the cloth.

Fig. 3, represents a plan of Ayton's Patent Spring or Instrument for producing elasticity, vibration, and permanent tension upon the bolting cloth. F G H are three concentric cylindrical rings, which form an universal joint, by means of the four screws *n n* and *o o*. The centre ring

or socket H, has a square aperture made in it, to fix an iron axis of a reel or winnow, one inch and one-eighth square; and when placed thereon, it may be fixed in any convenient part, by the two fixing screws *p p*. Should an axis be used, smaller than the aperture, great care must be taken to fix in a thin piece of iron, half the thickness of the spare space, opposite the points of the screws, in order to keep the axis perfectly in the middle; this is indispensably necessary.

q q q q q q are six elastic steel springs or arms, rivetted into the external ring F, the end of each is formed into a broad hook, made smooth, to receive the loops fixed to the tail leather of the bolting-cloth.

Fig. 4 represents a side view of fig. 3, the same letters of reference being applied to the same parts, wherever they can be seen.

Fig. 5 shows a section of fig. 3, taken through the line *r s*.

When this spring is applied upon the axis, and the loops of the bolting-cloth are placed in the hooks, a constant and uniform tenison will be kept up, producing a continuous vibration, by which means the action of the cloth is greatly increased; and should the cloth be reduced in length at any time, the spring may be shifted upon the axis to suit either an increase or decrease of length, as the case may require.

Although a net is here recommended to be applied to a winnow, yet it may be dispensed with at pleasure, without rendering the other appendages less efficient.

LXXVII.—*On the blowing of Air into Furnaces by a Fall of Water. By the late celebrated* WILLIAM LEWIS, M. D.

(Continued from Page 313.*)*

WATER descending through an oblique pipe, with lateral apertures.—I varied the foregoing experiment, by taking

instead of the crane, a leaden pipe, about ten feet long and three quarters of an inch bore. Several holes were made, at intervals, in the length of the pipe, and small tubes fixed into them, like the sucking pipe of the crane. The pipe being laid aslope, its upper end was turned up perpendicularly, and a funnel fitted to it, which was supplied with water by a cock in the bottom of a reservoir: the other end of the pipe, which the water issued from, was inserted into the air-vessel used in the preceding experiment.

The lateral tubes being stopped, and the cock so turned as to let the water run fast enough to keep the funnel always full, no air issued from the blowing pipe. On opening the tubes, a considerable blast was perceived; the water passed slower through the pipe, so that the same stream made the funnel run over; and on pulling out some of the tubes and looking in through the holes, the column of water was very visibly less than the bore of the pipe. The tubes being stopped again, the blast ceased, and the stream did no more than keep the funnel full.

A small variation in the circumstances of this experiment made a very material difference in the effect. The supply of water having been diminished, so as to rise only a little way above the throat of the funnel, a pretty strong blast issued from the blowing pipe, though all the lateral holes were closely stopped, and when the tubes were open, instead of air passing in by them, a blast passed out from them, the air-vessel in this case yielding none; so that here the air must have been introduced at the top, and passed down the funnel, and afterwards escaped where it first found a vent. To be further satisfied in this point I repeated the experiment, with a somewhat different apparatus, in the following manner.

Water falling through a Funnel.—The glass receiver of an air pump, about two feet high, open at both ends, had its lower end immersed about seven inches, in a vessel of water, and supported at a proper distance above the bottom

for the free passage of the water under the edges of it.—A brass plate being pressed close on the top, with a leather between, a glass funnel about twelve inches deep, and above half an inch in diameter in the throat, was fixed into a hole in the plate; and into another hole was fitted a small blowing pipe.

A stopper being introduced into the funnel, till the water it was filled with had become perfectly quiet, and then cautiously removed, the water ran in a stream, which falling into that in the receiver, produced air-bubbles, but no blast issued from the pipe; and when the pipe was stopped, the water in the reservoir did not sink lower than the level of that in the outer vessel; whereas, if any air had entered with the water, and been compressed in the receiver, it must have forced a proportional quantity of the water out below.

The funnel was then supplied from a pipe, by which the water was made to dash against the side of it. By this means, the fluid received a spiral motion, and whirling round the funnel, left a large vacuity in the middle, reaching down, sometimes, to the funnel's throat. The stream as it ran through, was also twisted; a sensible blast issued from the air-pipe; when the pipe was stopped, the water in the receiver was forced lower and lower, and was soon driven entirely out, abundance of air-bubbles following it into the water in the outer vessel.

When the funnel was kept entirely full, though the stream was directed against its side, there were little marks of any air being carried down. And when the funnel was nearly empty, the effects were also inconsiderable, the vacuity in the middle of the spiral circumvolutions of the water, seeming to reach to the bottom, so as to suffer the air to escape upwards, through the hollow column of water.

Water falling from a considerable height into a Funnel with a pipe.—A leaden pipe, six feet high and an inch and a half in diameter, was inserted into an air-vessel, with the water-gauge already described. Into the top of the pipe

was fixed a tin funnel, whose throat fitted close to it; and into the funnel a stream of water let fall, from a reservoir five feet above, in quantity sufficient to keep the funnel running over. This apparatus represents Marriotte's blowing machine, before described.

The water divided by the fall, pushed down abundance of air with it: a strong blast issued from the blowing pipe, and the gauge rose high. On raising up the funnel a little the stream that issued from it appeared all frothy: as often as the funnel was lifted up, the gauge sunk, the air which had been driven in by the dash of water escaping between the funnel and pipe; on letting down the funnel close, the gauge immediately rose again.

Instead of a fall of five feet, a stream was directed into the funnel, from only about half that height. The gauge still rose considerably, though not so high as before.

It is observable, that in the circumstances of these experiments, a whirling motion communicated to the water in the funnel, impeded the carrying down of air, the gauge always sinking on the water receiving such a motion.—Whereas, in those of the preceding article, it seemed to be by the whirling of the water, that the air was pushed down.

It appears, therefore, that there are two ways, of making air pass down with water through a funnel; one, by directing the stream against the side of the funnel, the other, by letting it fall from a great height: that in the one case the air enters between the spiral circumvolutions, which the water forms in the funnel; and, in the other, between the drops, into which a considerable part of it is reduced by the fall: that we cannot avail ourselves of both ways at once, the one impeding the effect of the other; and, that in either case, the air-holes under the throat, so necessary in other machines, can have no place, as they give a vent to the air brought down from above.

Water falling from a funnel through a pipe with air-holes.—The six-feet pipe, used in the foregoing experi-

ment, continuing fitted into the air-vessel, its upper orifice was widened that the small end of a funnel-shaped copper pipe, of the same bore with the preceding funnel, might hang freely in it, without touching the sides. The funnel pipe reached up to the reservoir, and was kept always full; that the water might receive little or no air, but at the vacuity, between the nose of the funnel and the leaden pipe.

In this situation, the quantitiy of air was much less than in the preceding; the water fell through the funnel in a stream not at all frothy, and the gauge rose but a little way. I widened the aperture of the leaden pipe to let in more air, but still the gauge continued low.

Into the orifice of the funnel I inserted a smaller pipe, whose diameter was one inch, and whose area was of consequence less than half of that of the leaden pipe. The blast was now strong, and the gauge rose higher than when the water fell from an equal height, into the low funnel of the foregoing article. I tried funnels considerably smaller, and found the gauge still to rise high: but at last, with one of a quarter of an inch in diameter, it did not rise at all, and no blast could be perceived.

One of the funnels which answered best, being properly fixed, with two or three inches of its neck hanging free within the wider pipe; I made several variations in the manner of admitting the water and air, with a view to compare the effects of different ways of admission. The funnel being full, and gently supplied, so as to keep the water in it as steady as possible, the height of the guage was marked: on giving a circular motion to the water, or letting it fall from a height, the guage always sunk, even a slight whirl or dash sensibly affecting its height. The space between the nose of the funnel and the pipe was stopped, so that no air could enter but at the top: the funnel being now full, and the water quiet, the guage scarcely rose at all; on whirling the water it rose considerably, and when the water fell from a height it rose further, though not so high as the standard mark.

It appears, therefore, that there are two general methods in which water may be made to carry down air; one in which it receives the air at the top, and the other through lateral apertures; and that the circumstances which contribute to the effect in the one case, impede it in the other: that water, being at rest in a funnel, and then suffered to run through, carries little or no air with it: that when made to whirl round in the funnel, it carries a considerable quantity; and that when it falls from a height, so as to be in part dashed into drops, it pushes down considerably more; that running through a pipe with lateral apertures, perpendicular or obliquely, it receives air through the apertures, even when its motion is slow; that when the pipe is of equal bore throughout, the quantity of air thus received is not great; but that, when the pipe is contracted to a certain degree, in the part where the apertures are, the quantity of air is greater than that introduced through a funnel without air holes: that air, brought down from the top of the pipe or funnel, prevents the introduction of fresh air through the lateral holes; which, in this case, instead of receiving more air, discharge that already received.

Finding that the two general methods by which air is made to pass down with a stream of water, could not be united in one machine, and that the pipe and funnel, with apertures for the entrance of air, about or under the throat of the funnel, have the greatest effect, I proceeded to examine the most proper form and disposition of these.

IV. *Experiments and Observations for regulating the structure of the funnel and pipe.*

Experiments with funnels and pipes of different heights. —The water, as already observed, passing through the narrow throat of the funnel, is afterwards enlarged into a jet, which fills the bore of a wider pipe. The quantity of air introduced appears to depend upon the degree of this enlargement, and on the quantity of water that runs through in a given time.

The greater the height of water above the narrow throat, the greater velocity will the jet receive, and the more it will be disposed to spread and be enlarged. The length of the pipe does not appear to be of so much importance; it should seem sufficient, if the pipe is of such length, that the pressure of the water in it may be able to resist the compressed air in this vessel; and that after part of its power has been spent in overcoming that force, it may still have velocity enough left to run down as fast as it can be supplied from the funnel. In order to arrive at some determinable proportions, the following trials were made:

A leaden pipe, seven feet high, and an inch and a half in diameter, being fitted into an air vessel, as in the foregoing experiments, funnel-shaped pipes, of different heights, were supported over it, so as that the small end of the funnel might hang freely in the orifice of the leaden pipe, and leave space enough for the entrance of air all round. For the greater security of the throat being of the same area in all the funnels; one and the same copper pipe served as a throat for them all: the funnels being formed, by inserting this pipe into larger tapering ones, of different heights. The funnels were always kept full, and the water conveyed into them as gently as possible, so as to produce no dashing or whirling motion.

A funnel of one foot high had very little effect: the rising of the guage in the air-vessel was inconsiderable, and the stream of air from the blowing-pipe was but just to be felt: on opening some holes made in the leaden pipe, under the throat of the funnel, the jet of water appeared not to spread, but was rather contracted, and did not fill the bore. With funnels of two or three feet the gauge rose more, and the jet spread, though it did not appear to fill the pipe, till it had reached about half way down to the bottom. Funnels about five and six feet high, produced a strong blast, and kept the gauge high, the jet filling the pipe, before it had fallen a foot below the throat of the funnel.

On many repetitions and variations of these experiments,

I have not observed that the jet spread sufficiently, with less than a fall of five feet. With a fall of sixty-four inches, the gauge rose more than five times as much as with one of sixteen inches; though the quantity of water which ran in the first case, was only double to that in the latter one; viz., as the square roots of 64 and 16: from whence it is plain that the above differences do not depend entirely on the different quantities of water which run through the funnels of different heights; but, in great part, on its different velocity. Some other experiments seemed to confirm this point: for, having used short funnels, so much wider than the high ones, that the quantity of water discharged by the former, was equal to, or greater than that by the latter; the short tunnels never produced so strong a blast, or raised the gauge so far as the others.

Being satisfied of the advantage of having the funnel of a very considerable height, I, in like manner, varied the length of the pipe. Having made a mark at the part where the gauge rose to, when the funnel was five feet long, and the pipe seven, I added to the pipe about a foot more; the gauge scarcely rose any further. A foot being cut off from it, the gauge fell a little: two feet being cut off, it fell considerably; and the retrenchment of another foot made the machine of little effect, the gauge sinking almost to the bottom, and the blowing pipe yielding but a weak current of air. The pipe, reduced thus to four feet, was tried with a funnel of near eight feet long; in this case there was no blast at all. But, with funnels, less than its own height, as of two and three feet, it still raised the gauge considerably.

It appears from these experiments, that in most of these machines described in the preceeding section, the lengths of the funnels and pipes are greatly disproportioned to one another; and consequently the water applied to disadvantage. Those of Dauphiny in France are particularly faulty in this respect, the funnels being scarcely three feet high, and the pipe twenty-five or twenty-six; with so small

a height of water above the choak, I have never been able to make the jet spread near to such a degree, as it is said in the machines of Dauphiny, without particular contrivances for that purpose, which will be mentioned in the sequel of this paper.

The Foix machine agrees the best with my experiments; but, as the funnels of the others; are undoubtedly much too low, that of this seems to be rather too high. The effect seems to be the greatest when the funnel is about two-thirds the length of the pipe.

Experiments of the Disposition of the Air-holes.—In the foregoing experiments, the simplest and most obvious way of admitting air was chosen, by leaving a space between the funnel and pipe.

The air-pipes of the machines of Foix and Languedoc answer the same end, carrying in the air above the surface of the jet of water. As the other machines have the air-holes under the jet, I tried what variations would result from this circumstance, and from making the apparatus of different depths, under the throat of the funnel.

Into a pipe of six feet in length was fitted a funnel of four feet; and six inches below the orifice of the funnel four holes were bored round the pipe, sloping down from without, inwards: eight inches lower down, I made another row of holes; and at like distances under these, a third and a fourth. To each hole was fitted a stopper, which exactly closed it.

All the holes being stopped, the funnel was first hung free in the pipe, as in the former trials, and the height to which the water rose in the gauge was marked. The funnel being then let down into the pipe, so as exactly to close it, the upper air-holes were opened; the gauge did not now rise so high as before. The upper air-holes being stopped and the second row opened, the gauge continued at its last height. With the third row open, it rose rather higher than the first mark; and with the fourth, it fell the lowest of all.

The several entrances for the air were then opened by two and two. With the space between the funnel and pipe, and the upper air-holes open, the gauge did not rise so high as with the space only; and with the upper, and second row of holes, it continued at the same height.—With the second and third it rose considerably further, though not up to the first mark; and with the third and fourth it fell a little below the preceding height. In all these cases, where two rows of holes were open, the water manifestly did not fill the bore of the pipe at the upper holes; but spread so as completely to fill it, by the time it had reached the lower ones: at which last, part of the water spirted out, and carried some of the air with it.

In another pipe of the same size, I made two sets of air holes, three inches apart, and the uppermost of them twelve inches from the orifice of the funnel. With the uppermost row open, and with both rows open, the gauge rose almost equally, being only a little lower in the latter circumstance than in the former; but with only the lower row open, it sunk about one half. These being all stopped, and another set bored opposite to the orifice of the funnel, the gauge rose as high as in the first case.

These experiments, and several others I have made on the same subject, are not so conclusive as I should wish. They seem to show that it is more eligible to have the entrances for the air in one horizonial plane, than in two planes above one another; and either above or at some distance below the jet, than immediately under it: that they ought to be of greater magnitude than in some of the machines described in the first section, particularly in that of Lead-hills, whose air-holes, taken altogether, are not of half the area of the space in the pipe which the air has to fill. They ought, at least, to be of an equal, or rather of a double extent, that the air may enter the more freely.

(To be continued.)

LXXVIII.—*Practical Observations and Results, in the Manufacture of Iron from the ore into blooms, in Shropshire. By* ARTHUR AIKIN, *Esq. Secretary to the Society for the encouragement of Arts, Manufactures, and Commerce, &c. &c.*

DEAR SIR, *Society of Arts, &c, &c., Adelphi, Nov.* 22, 1825.

PERCEIVING in the *Technical Repository* many interesting practical communications respecting Iron and Steel, the following particulars may, perhaps, not be unacceptable. They are the result of enquiries made by me, some years ago, *under very favourable circumstances*, respecting the practice pursued at a large Iron Smelting Work in Shropshire; and which, at that time, produced some of *the best Iron* in the English market.

I am, Dear Sir, yours,

T. GILL, *Esq.* ARTHUR AIKIN.

Process of Puddling Iron, as practised at the Lightmore Works, in Shropshire.

The different stages of the manufacture, from the ore to the making blooms, are, briefly, the following:—

1. The roasted ore, being mixed with limestone, is reduced in the *high smelting furnaces*, (with coak), which are *tapped* at regular intervals; and the melted iron runs into furrows, made in sand, and thus forms *pigs*.

2. The pigs, being broken into two or three pieces each, are re-melted in the *refinery furnace*, (with coak) and the produce being let out into a shallow, flat, cast-iron trough, forms thick plates, called *slabs*.

3. The slabs being broken, are melted in the *puddling furnace*, (with coal), and brought out in large masses, called *balls*; which, while yet glowing hot, are;—

4. Laid under a very heavy hammer, and *stamped* into *plates*; which are then thrown into water, in order to cool them.

5. The plates being broken, the pieces are piled one

on the other, to the height of about a foot and a half, and placed in a *reverberatory furnace*, called a *balling furnace*; from which, when sufficiently heated. (by coal) they are removed to the *shingling hammer*, where they are beaten into short, thick bars, called *blooms*.

The following are the particulars observed during the process of Puddling

The furnace employed is a *reverberatory* one, of very simple construction, and the fuel used is coal. The flat area of the furnace being previously covered with sand, the charge was put in, consisting of 3½ *cwt.* of broken slabs, which were heaped up loosely in the middle of the furnace. The door was then carefully closed, and the full force of the flame was let on. In about half an hour the door was opened, and the glowing metal being partly fluid, the workman was engaged in breaking and spreading it for about five minutes, water being thrown on occasionally in small quantities, by a scoop, and being immediately succeeded by much ebullition, and the disengagement of copious jets of white light. The spreading being completed, the door of the furnace was again closed, and the flame turned on for two or three minutes. The door was then opened, the flame turned partly off, and the charge worked by incessant stirring; a few wet scales of iron, and water in small quantities, being occasionally added: the charge now began to grow pasty, and to adhere to the tools. The fire was still further damped, and water, in small portions, was frequently added; the mass being incessantly worked with great vigour: the jets of flame were very copious, and the metal still pasty, and adherent to the tools. The working of the mass was still continued, but without the addition of water; and soon after the metal began to lose its coherence; more water was then added, and the breaking down of the metal proceeded rapidly; it still, however, adhered more or less to the tools, till it was reduced to the consistence of coarse gravel;

at this period, the jets of white light were succeeded by a heavy red vapour, indicating the necessity of more heat: the full force of the flame was then let on, the door of the furnace continuing open, and the workman adding water, and stirring the mass incessantly; the jets of white light reappeared, the metal became of the consistence of coarse sand, and began to *come into nature*, i. e. to *clot*. The iron now burned rapidly, with an intense white light, upon which the fire was damped a little; the metal was every minute becoming more cohesive, it was of a glowing white, and burnt away very fast; water, in small quantities, was still added. The metal was now of a pasty consistence, and did not adhere to the tools; *it was come completely into nature*; and was made up into several lumps; one hour and a half being expired, from the first charging the furnace.

The door of the furnace being now closed, the full force of the fire was let on for two or three minutes; after which, the door being opened, and the flame damped, the lumps were *dollyed*, i. e. compressed and beaten with a heavy iron mace; and were made up into five nearly equal balls; one hour and three quarters being now expired.

The balls, glowing hot, were then removed from the furnace to the *stamping hammer*, where they received from 70 to 100 blows each, and were thus formed into rough plates; being then cooled in water, they were weighed, and amounted, in the whole, to two hundred weight, three quarters, and nineteen pounds, or nearly 86 per cent.

The following Answers to Queries addressed by me to the manager of the Works, cannot but prove interesting.

On Roasting the Ore.

Query 1.—How much coal, and of what kind, is employed in roasting the ore, per ton?

Answer.—Five hundred weight. We used small coal from the pits.

Query 2.—How much time does this process require?

Answer.—It may be done in a week, in small quantities; but it is better done, and much cheaper, in large quantities.

Query 3.—What loss of weight does the ore undergo?

Answer.—Nearly one fourth.

On Making Coal into Coak.

Query 4.—What kinds of coal are made into coak?

Answer.—All the kinds, excepting the *stinking coal*, (that abounding in pyrites,) but *top coal* makes the best.

Query 5.—What time does the process require?

Answer.—From five, to seven or eight days.

Query 6.—What is the loss of weight in converting coal into coak?

Answer.—One half.

On the Limestone employed in Smelting.

Query 7.—What are the different varieties of limestone that are employed?

Answer.—The Wenlock and Littleshall.

Query 8.—Why is the Littleshall reckoned the best?

Answer.—Less weight of it, is said to flux more ore; and it comes cheaper than the Wenlock.

On Smelting the Ore.

Query 9.—What are the relative proportions of *Penny-stone* and *Spar-stone*, (the two varieties of iron ore, used at the works?)

Answer.—We mix about one-twelfth of spar-stone with penny-stone.

Query 10.—What proportion of limestone is employed?

Answer.—About ten hundred weight of Littleshall. Rather more, if the Wenlock stone is used.

Query 11.—What proportion of coak is employed?

Answer.—Forty-five hundred weight to a ton of iron, on an average of the different kinds.

Query 12.—The number of runnings, and weight of metal obtained in twenty-four hours?

Answer.—Two runnings, and about seven tons of iron, if for forge-pigs; not more than six tons, if for melting pigs. This depends upon the size of the furnace.

Query 13.—How much roasted ore is required for a ton of iron?

Answer.—Forty-five hundred weight is the general calculation: but we worked at forty-two hundred weight to a ton.

On Pig Iron.

Query 14.—The names, external characters, and properties of pig iron?

Answer.—*Grey, white, smooth,* and *honeycomb* pigs. The smooth-surfaced pigs are highly blown, and are used for melting into castings. The honey-combed pigs are used for forge-iron.

Query 15.—On what circumstances do the varieties in pig-iron depend?

Answer.—The smooth surfaced pig-iron, has had more blast in a given time. Farther than this, I cannot say. It would have been a very valuable circumstance to us to have been able to answer this question more satisfactorily.

Query 16.—Does Littleshall limestone afford better iron than Wenlock limestone.

Answer.—I do not imagine that the experiment has ever been made; but I can say, that we have worked for months together, with Wenlock limestone, and have had as good iron, as when the Littleshall was used.

Query 17.—What effect has the temperature, and the dryness or moisture of the air, on the smelting; and on the quantity or quality of produce?

Answer.—In cold and dry weather, we had more and better pig-iron, than when the air was hot and moist. I regret that this question cannot be answered in a better manner.

On Refining the Iron.

Query 18.—Are not the different qualities of pig-iron mixed in certain proportions, in the refining?

Answer.—They are, sometimes; but the refined iron is generally of a better quality, when the pig-iron is all of one sort, viz. with a honey-combed face, and with an open, bright grey fracture.

Query 19.—What is the produce in refined iron *(slabs)* per ton, of pig-iron?

Answer.—Sixteen hundred weight, two quarters, and twelve pounds. The workmen are expected to produce a ton of slabs for every twenty-four hundred weight of pig-iron.

Query 20.—The quantity of coak used for each ton of slabs?

Answer.—Seven hundred weight and two quarters.

Query 21.—The time required for the process?

Answer.—Two hours.

Query 22.—What are the external characters and properties of good slabs?

Answer.—A honey-combed surface, and a bright, silvery, glistening fracture.

On Puddling and Stamping the Iron.

Query 23.—What is the produce of stamped iron per ton, of slabs?

Answer.—Seventeen hundred weight, one quarter, and sixteen pounds. The workmen are expected to produce a ton of stamped iron, for every twenty-three hundred weight of refined iron, or slabs.

Query 24.—How much is required in the preparation of one ton of stamped iron?

Answer.—About twenty-five hundred weight.

On the Blooms.

Query 25.—What is the produce in blooms per ton, of stamped iron?

Answer.—About sixteen hundred weight, three quarters, and ten pounds. This was our average quantity in two years.

Query 26.—How much coal is used in the preparation of one ton of blooms?

Answer.—About twenty-two hundred weight.

Query 27.—What are the external characters and properties of good blooms and bad ones?

Answer.—Good blooms should be of a bright lead colour, and should break wiry and tough. Bad blooms are of a dirty red colour, and break short.

The following is a tabular arrangement of the ingredients and produce of each operation, calculated on one ton of blooms. The numbers express cwts. and their decimal parts.

91.41 raw ore	+	22.85	small coal produce	68.73 roasted ore.		
68.73 roasted ore	+	147.28	coal, (73.64 coak)	+	17 limestone	= 32.73
pig iron.						
32.73 pig iron	+	20.46	do. (10.23 coak)	- - - - -		= 27.26
refined.						
27.26 refined iron	+	2965	- - - - - - - - - - - - - - -			= 23.73
stamped.						
23.73 stamped iron	+	22. 0	- - - - - - - - - - - - - - -			= 00.
blooms						
		248.24				

LXXIX.—*A discourse, delivered at the opening of the session of* 1824, *of the Helvetic Society of Natural Sciences, held at Schaffhausen the 26th, 27th, and 28th of July. By Lieut. Col.* FISHER, *President of the Society for the current year.*

. . . . . Nec aranearum sane textus ideo melior quia ex se fila gignunt, nec nostor vilior quia ex alienis libamus ut apes.

Jast. Lips. Monit. Polit. L. 1. *Cap.* 1.

VERY DEAR FRIENDS AND COLLEAGUES!

WE are entering the tenth year, dating from the memorable epoch, in which a citizen of Geneva, a city whose right

it seems to have been for ages to produce distinguished men, conceived the happy idea of founding an Helvetic Society, devoted to the culture of the *natural sciences*, and invited to his picturesque hermitage of Mornex, upon Mount Saline, the few friends of nature which formed the nucleus of this association. Whatever might have been the views and hopes of this learned and zealous philanthropist, at the birth of this society, the extension and consistency which it has acquired have unquestionably much surpassed them; and could we have the happiness to see him again amongst us,* he would enjoy with enthusiasm the circumstance which now unites upon the northern limits of Switzerland, in a little town, deprived of the resources with which the greater number of its sisters of the confederation are richly provided, the elect of the naturalists of Helvetia, under the laudable aim of reciprocating their information and their discoveries, of enjoying the personal relations which every succeeding year enhances in their estimation, and of congratulating each other in belonging to a country which the Creator has endowed with his noblest gifts.

Welcome—thrice welcome, my dear friends and colleagues,—you, whose presence now animates and adorns our happy town! I salute you in behalf of those of our venerable magistrates, who honor us with their presence, and in behalf of our government, which designs liberally to encourage our efforts by a donation of 600 francs. I salute you in the name of my beloved fellow-citizens, who rival each other in their desires, to evince to you the hospitality, and who would be glad to retain you a long time in the midst of their families; and I salute you in behalf of our cantonal society, of which I am at present the organ, and which will have to offer you, at this session, the modest tribute of its labours of the year. But the exercise of the presidency to which I find myself called,—of a function so

* Mr. Gosse, founder of the society, who was removed by death a few months after its formation.

new to me, inspires me with a just and well-founded apprehension. The fresh recollection of the superior men who have acquitted themselves of this duty in so distinguished a manner; the comparison of my feeble means with those with which they have been endowed, and of which they have given proofs, alarms me in the highest degree. I have need of all your indulgences, my dear and honoured colleagues; and I claim it with anxiety, and in the name even of that benevolence, which assigned to me, at our last annual meeting, the suffrages, in virtue of which I have the honour now to address you.

In conformity to the example of my learned predecessor, Professor Bronner, I shall endeavour to trace out succinctly the discoveries made in natural science, since our last annual meeting. There is not much perhaps in this review, which lies beyond the field of physical science; but I shall venture upon a circumference more extensive, and more analogous, perhaps, to the title of our society, and to its constitution, which embraces, in some sort, the whole of nature, and directs by turns the attention and researches of our numerous coadjutors* towards every object of interest which it can offer, and whose number is without limitation.

Not only are the sciences of nature and observation so connected with each other as to form an uninterrupted chain; they have become at the present time, intimately allied to the exact sciences, by the medium of the atomic theory, which, pursuing in thought the elements of bodies far beyond the feeble powers of our senses, has discovered in the varied combinations of those indivisible elementary molecules, *simple relations* both of weight and volume; a discovery which has opened the way to a rigorous arithmetical calculation in cases wherein it was before necessary to remain satisfied with vague and uncertain estimates. Not only are these calculations, for the most part, the result of actual chemical analysis—they often prepare the

*The society has now 415 members, and 114 foreign associates.

way for them and decide upon their conclusions *a priori*; and the experience of the manipulating chemist, does but confirm what the theory had foretold, by the learned and judicious application of the science of numbers. We are indebted to Higgins for having opened this path; but it was only a faint glimmering of the truth, until, by the meditations and labours of Dalton, Wollaston, Davy, and Berzelius, it assumed a high degree of interest among the physico-mathematical sciences, and became a guide, and even an instrument of research in the hands of the distinguished men just mentioned, and whose simultaneous existence, and active co-operation form in our own time, an epoch in the annals of science.

Passing from these events, which are in some sort European, to those on account of which our own country has a right to our felicitation, I must refer for details, to the special reports of the cantonal societies of Zurich, Berne, Geneva, St. Galle, Lausanne, Arau, Schaffhausen, and of our younger sister of Soleure, who has this year entered upon the career under the happiest auspices. It is, I repeat, to an *expose* of the annual labours of these societies, which will be laid before you in the course of the present session, that I must refer for all the particulars. I shall only at this time, turn your attention to a few of the principal objects. I rank in this number the applications which have been made of the brilliant discovery of Dobereiner of the singular property possessed by the spongy oxide of platina, of becoming suddenly incandescent in contact with hydrogen gas, at the common atmospheric temperature, and of producing acetic acid, by the combustion, without flame, of alcoholic vapour. You will perceive that our learned colleague, Professor Bronner, of Berne, has succeeded in rendering more and more easy the production of the metalloïdes of potash and soda, by the dry method, and that the experiments of M. de Serullaz upon the alloys of "kalium" with various metals have been successfully repeated in our laboratories; and that explosive combinations have also been obtained, by means of which gunpow-

der may be easily fired under water. The experiments of M. Irminger, of Zurich, upon strontian will be permitted to possess interest, as well as the property of the salts, which have this earth for their bases to give to flame a beautiful purple tint, an effect which has been already applied to pyrotechnics, with brilliant success.

Passing from the metalloids to the metal, you will have occasion to appreciate the discovery of the British Chemist Lucas, viz. that the contact of powdered charcoal with silver and copper in fusion, deprives them of the small portion of oxygen which adheres to them in that condition. But we have established by our experiments, that this effect holds good, not only with respect to the metals above named, but, under similar circumstances, it formed with melted steel, vegetations and crystallizations quite as remarkable. Messrs. Faraday, in England, and Berther, in France, have examined the alloys of steel and chromate of iron; we shall place before you essays of this kind, obtained in our own shops, and you will then witness chromated steel, perfectly ductile, the fracture of which shows the most beautiful *moire* possible. We are induced to believe that the true Damascus blades are not, as has been long supposed, a medley of iron and steel, but rather of various alloys of steel with other metals. To conclude, metallurgic chemistry has been recently enriched by the discovery, due to Professor Zain, of Copenhagen, of Xanthogene, a compound belonging to the class of cyanurets. It is well known that physics, encroaching to a certain extent upon the domain of chemistry, has attempted with success, to produce by strong mechanical pressure, combinations which, until the present period, had been obtained only through the agency of corpuscular attraction. We have now two examples, the one acetic acid crystallised under a pressure of 1100 atmospheres; the other a crystallization of salts, contained in sea water exposed to a pressure of 4000. Guided by the profound theory of Ampère, relative to dynamic electricity, our colleague, Professor De la Rive, jun. has determined, by means of an

ingenious apparatus of his invention, the various directions which are pursued by electric and magnetic fluid, and their reciprocal influence. The calorimotor and deflagrator of Prof. Hare, imported from America into our cabinets, opens to us the hope of contributing something to the future progress of voltaic electricity.

But our true field, that which nature displays in our mountains, and which she invites us to cultivate with activity and perseverance, is natural history. Here she exhibits to us numerous mineral and thermal waters, endowed with energetic medicinal qualities; there, geological phenomena, varying from the highest central and primitive chain, to rocks of transition, and thence to secondary and tertiary chains, and even to monuments of diluvian catastrophes. The chain of the Jura alone, presents to geologists an object of interest and curiosity the most enticing in the fossil remains of antediluvian animals, which our clear sighted and indefatigable colleague Prof. Hugi has discovered, petrified in the lowest beds of that chain, in the vicinity of Soleure. Besides, there have been found in the coal mines of our region, and will presently be laid before you, well preserved remains of animals of a former world, no longer found upon the earth. Researches for coal, as an article of fuel, is an object of the highest interest to the whole of Switzerland in all its economical relations; and a society has just been formed at Geneva for this special object. The working of salt springs, so happily facilitated by the use of the borer, has been attended, in a neighbouring country,* with brilliant success, and affords legitimate hopes of important consequences in our own. Zoology, in all its branches, presents to us a vast field. Mammifera, birds, fish, reptiles, insects; Switzerland presents within her inclosure, specimens more or less interesting of the whole organic kingdom, and the same may be said of mineral varieties, as is evinced by the rich collections of these objects already formed in

* The Grand Duchy of Baden.

some of our cities, and which are receiving almost daily augmentation.

From our lowest plains to our summits covered with eternal snow, we possess also every variety of climate within the limited circle of our twenty-two republics. Meteorology will receive, we trust, a regular and uniform system of observations, which it is now in contemplation to establish in all the chief places of the cantons, previous data for uniting and comparing, The management of our forests, an object of the first importance, will also engage the attention of our society; and in the present session we shall recieve some information from our colleagues, Profs. Pictet and Decandolle, upon the track which they propose to follow in those two branches of philosophical research, as well as in those whose object is the hypsometrical determination of the height above the level of the the sea of all the principal points of Switzerland, and of the various declivities of its rivers. The hydrotechny of our country is particularly interested in these determinations; and the memorable labours of the Linth, (which cannot be recalled without honouring with profound regrets the memory of the benefactor of that country;) the success, I say, of these labours have convinced us of the importance and of the possibility of the success of these extensive drainings, which are needed in numerous swampy plains; operations which render to agriculture large quantities of unproductive lands, and cause salubrity to prevail, where nought but pernicious influences held their reign. But it is time to finish these general and preliminary considerations.

I should abuse your indulgence, very dear and honoured colleagues, if I any longer interrupted your proceedings. My duty is confined to directing your observance of the *order of the day* as prescribed, according to custom, by the committee of direction, assembled prior to the opening of the session.

Bibliotheque Universelle, September, 1824.

LXXX.---*On "The Elements of Geometry, or a New and Compendious Demonstration of the First Six Books of Euclid; with many new and useful Propositions, Practical Rules, Examples, and Observations. By* ROBERT WALLACE, A.M. *Professor of Mathematics in Anderson's Institution, Glasgow," &c. &c.*

THIS is another of those highly useful works for which the public will have to acknowledge itself indebted to that patriotic spirit, instigated by which the scientific professors of the above Institution are induced to smoothen the difficult paths of science.

We believe we cannot do better than to publish the following prefatory remarks, as indicative of the design and nature of the work:---

"There is no Royal Road to Geometry," said a venerable sage of antiquity, the father of this sublime science; and succeeding ages have acknowledged the truth of the observation. The king and the peasant have been obliged alike to tread the same beaten path in the acquisition of mathematical knowledge, and to no work have they ever been more indebted than to Euclid's Elements. The praises that have been bestowed on his immaculate treatise, have tended not only to stimulate curiosity, and to excite admiration, but to make future authors despair of ever reaching such perfection. It must be allowed, however, that perfect as that work is, and forming one of the most splendid monuments of ancient genius, still there is to be found a shorter road than his to Geometry. It would be wonderful, indeed, if, in the lapse of two thousand years, no improvement could be effected in the elementary department of a science, in which such great and important advances have been made in modern times.

Notwithstanding the preference, therefore, which Simson, Playfair, and their followers, have generally given to the ancient mode of demonstration, it cannot be denied, that the Elements might be considerably condensed,

and more adapted to the present state of science. With the celebrated Barrow, the tutor and the friend of Newton; Hutton, Legendre and others, who have attempted to simplify the Elements, I have endeavoured to give them a new and more general form, and by the assistance of a science unknown to Euclid, to shorten the whole of his demonstrations. His reasoning, though beautiful and convincing, is long and laborious, full of repetitions, and not unfrequently employed about such very simple propositions as might either be taken for axioms, or very shortly discussed. By abstracting the science too much from the sensible objects to which it owed its origin, he sometimes leaves the mind in doubt about the reality of its conceptions; and although his demonstrations are perfectly rigorous and irrefragable, according to his previous definitions and postulates; yet if these latter are unnecessarily limited and refined, and consequently not clearly comprehended, the former must be liable to the same degree of uncertainty. It is hoped that the reader will find most of these difficulties, under which the Elements have long laboured, in a great measure removed in this work.

Though there be no *Royal*, yet there is a *Mechanical* Road to Geometry, and the preceding remarks cannot perhaps be better illustrated, than by quoting the case of a celebrated mechanic and practical astronomer, James Ferguson. Dugald Stewart speaks of him in the following words:—"I remember distinctly to have heard him say, that he had more than once attempted to study the Elements of Euclid, but found himself quite unable to enter into that species of reasoning. The second proposition of the first book he mentioned particularly as one of his stumbling-blocks at the very outset;—the circuitous process by which Euclid sets about an operation which never could puzzle, for a single moment, any man who had seen a pair of compasses, appearing to him altogether capricious and ludicrous. He added, at the same time, that as there were various geometrical theorems of which

he had daily occasion to make use, he had satisfied himself of their truth, either by means of his compasses and scale, or by some mechanical contrivances of his own invention. Of one of these I have still a perfect recollection;—his mechanical or experimental demonstration of the 47th proposition of Euclid's First Book, by cutting a card so as to afford an ocular proof, that the squares of the two sides actually filled the same space with the square of the hypothenuse."

If such were the case with a man so celebrated as Ferguson, what must be that of thousands less remarkable for ingenuity. The second proposition of the First Book of Euclid's Elements, is nearly as much entitled to the appellation of the *Pons Asinorum*, as the Fifth; and as many have, in the author's recollection, been deterred from the study of Geometry, by Euclid's definitions of a *point* and a *line*, as by that proposition. Beginners must be allowed to attach physical and mechanical ideas to the subjects of Geometry at first, otherwise they can never make any progress; as they advance, the clouds and mist which enveloped the entrance disappear, and they soon begin to see clearly the object of the science. When this is once attained, all their difficulties vanish, and the beautiful chain of demonstration, by its regularity and strength, strikes the imagination with as much force as the rich colouring and highly wrought imagery of the poet. It is then that science appears in her native purity, shining with such a brightness of intellectual light, that the geometer is convinced those sublime truths would be eternally the same, though the whole frame of nature were dissolved, and the material world reduced to its pristine chaos.

The present work, composed amidst the laborious duties of a teacher and an editor, contains the result of several years' experience; and though calculated for the use of those who have little time for study, is probably not unworthy the attention of those who have more leisure. The principal improvements consist in a system of reference

adopted to save unnecessary repetition, and in the use of the *most common arithmetical signs*, by which the eye is made to assist the understanding, as in Algebra. "By that means," as Playfair beautifully remarks, "the work is translated into that universal language so much sought after in all the sciences, but destined, it would seem, to be enjoyed only by the mathematical." Indeed, so much is this the case, that a book on Algebra is nearly as well understood by a person who is at all acquainted with the science, whether it be written in his own tongue or in that of Hindostan; and the Binomial Theorem will be comprehended at a glance, in whatever language it may be expanded. The author's attempt has been, to bring Geometry as much as possible to the same state of universality and perfection; how far he has succeeded remains for the candid to judge.

He has devoted particular attention to one point of the utmost importance to the student, namely, the shortening of the enunciations, or expressing them in as few words as possible. To dwell on the utility of this improvement is quite needless; those who have experienced the difficulty of remembering Euclid's enunciations, can alone appreciate its value; suffice it to say, that many enunciations have been reduced to half their former length, yet strictly retaining the same meaning. The addition of many important corollaries to each proposition, is another feature of the work; to which may be added, one of no less value, that wherever the enunciation of a proposition involved two or three distinct propositions or cases, or their converse; it is divided, and separately demonstrated; the advantage of this method will be duly appreciated by the teacher.

Two other improvements remain to be noticed,—the *Practical* Rules, Examples, and Observations, interspersed through the work, and the Problems for Exercise subjoined. The former are of the utmost consequence, in showing the student the use of the science, and in

leading him by degrees to apply it to practice; the Mensuration of Plane Surfaces is particularly illustrated, so as to enable him to prosecute this useful branch to any extent. Some interesting specimens are given of the application of Algebra to Geometry, a most useful and fertile branch of the Mathematical Sciences, and to which we are mainly indebted for the wonderful improvements made in Natural Philosophy, since Newton, like a guiding star, first led the way. The Problems for Exercise will serve as excellent stimulants to ingenuity, and to increase a taste for the science; for the student may rest assured, that the solution of these, by his own skill, will have a greater effect in increasing his scientific powers, and enlarging and fixing his knowledge, than the mere study of books on the subject for years.

It is a great satisfaction to the author, to find that the plan of Mathematical Instruction, which he had practised and now gives to the public, coincides with the ideas lately promulgated by a highly competent judge of its utility. Mr. Brougham, in his "Practical Observations on the Education of the People," thus remarks:—"He who shall prepare a treatise, simply and concisely unfolding the doctrines of Algebra, Geometry, and Mechanics, and adding examples, calculated to strike the imagination, of their connexion with other branches of knowledge, and with the arts of common life, may fairly claim a large share in that rich harvest of discovery and invention, which must be reaped by the thousands of ingenious and active men, thus enabled to bend their faculties towards objects at once useful and sublime."

No. 2, George's-square, Glasgow, July, 1825.

LXXXI.—*Mr.* BARTON'S *Reply to Mr.* P. A. BROWNE, *and a Notice of the Success of his Metallic Pistons in Cornwall.*

DEAR SIR, *Huland Mines, Nov.* 21, 1835.

I AM very much surprised at the assertion of Mr. P. A. Browne and Mr. Holden, of Philadelphia, that I am not

the inventor of the metallic pistons with wedges, for which he, Mr. Browne, has taken out a patent in the United States, as his invention; and still more, for him to say that he had a model of it* before he left the United States, which is alike untrue, for he was introduced to me by Mr. Mortimer, of St. James's-street, gunmaker, in July, 1816, and represented to me as a gentleman from America, who wished to get any invention he could turn to profit in America: he saw my piston, was pleased with it, and agreed to give me the half of what he should make of it, under a patent, in America, and which share I naturally expected to have received. Mr. Mortimer, I have no doubt, recollects the circumstance, and can prove it. I should have replied before, but have expected to be at home for some time past; I think now it will be within a fortnight.

I am happy to say, that I have had one of my metallic pistons, or buckets, in work here above four months, and it has never even been seen; others above three months in the sinking lift, where leather would not last a week. I have entirely removed the need of leather in the pumps here: I have also one engine with my piston and air pump bucket at work here; and I have little doubt, but that in deep mines I shall be able to save near a third in the water charge. I will call on you very early after my return.

I have had the most violent opposition from the agents and engineers, but I have accomplished all that I proposed; it has, however, been with the most unremitted attention. I hope I shall have some communications for you soon, which will be worth your notice.

I am, dear sir, yours truly,

To T. GILL, *Esq.* JOHN BARTON.

P. S. My papers relative to Mr. Browne being in London, I cannot give more particulars.

* Not exactly so, but that he had invented another, and which might be applied to similar purposes.—EDITOR.

THE

TECHNICAL REPOSITORY.

LXXXII.—*On the Comparative Safety of High and Low Pressure Steam-Engine Boilers. By Mr.* A. B. QUINBY.*

WITH A FIGURE.

New York, June 28, 1824.

THE following is the substance of a paper communicated by the author to the committee appointed by the Literary and Philosophical Society of the City of New York, to investigate the causes which gave rise to the explosion of the boiler on board the steam-boat Ætna.†

To determine the comparative eligibility of the *high* and the *low* pressure engine, the two following things appear to me necessary to be considered. *First*, the liability of each engine to explode; and, *secondly*, the danger or injury which each engine is capable of producing, in case an explosion takes place.

To determine the comparative liability of the two engines to explode, it will be necessary to consider the four following things:—the diameters of the boiler sused in the two engines; the elastic force of the steam in each boiler; the tenacity of the metal of which the boilers are composed; and the thickness of each boiler.

The diameter of the boiler on board the Ætna was thirty inches; and the diameter of a boiler for a *low* pressure steam-engine, of great power, would be about ninety inches, or *three times* as great.

The elastic force of steam in the boiler of the Ætna was

* From the American Journal of Science and Arts, Vol. IX.

† The communication was made at the request of Dr. Dekay, Chairman of the Committee.

usually 150lbs. per square inch; and the elastic force of steam, in a *low* pressure boiler, is usually 10lbs. per square inch.

The tenacity of the metal of which boilers are composed is about 60,000lbs., or six-sevenths that of good wrought iron.*

As, however, the cylinder which constitutes the boiler is not solid metal, but is composed of plates, *riveted together*, it will be necessary to diminish the number which expresses the tenacity.

Let, therefore, the tenacity be put at 30,000lbs. in place of 60,000.

The thickness of the boiler in the Ætna was three-eighths of an inch; and the thickness of a *low* pressure boiler, for an engine of equal power, would be about $\frac{1}{4}$ of an inch.

From these data, it is easy to calculate the comparative liability of the two boilers to explode; for, (by mechanics), the force of steam, which a *high* pressure boiler, 30 inches in diameter, and $\frac{1}{4}$ of an inch thick, is capable of resisting, is equal to the thickness, multiplied by the tenacity of the metal, and divided by half the diameter;† $\frac{1}{4} \times \frac{30{,}000}{15} = 750$lbs.; which is 600lbs. more than the

* The tenacity of any metal is usually expressed by the greatest weight in lbs. which a bar of that metal is capable of sustaining when pulled endwise.

† The formulæ, for the elastic force of steam, which a given boiler will sustain, may be derived in the following manner;

Let the circle A D B, (see Plate XII. Fig. 1.) represent an end projection of a boiler, one inch in length. And put (ts) for the tenacity of the metal; e, for the elastic force of the steam employed; r, for the radius of the boiler; and (th) for the thickness of it.

Then $r : \frac{2r}{3.14159, \&c.}$, (the mean distance of the semi-circle A D B, from the line A C B,) $:: e : \frac{2e}{3.14159 \&c.}$, the *mean* elastic force of the steam employed, (acting upon the surface A D B,) inflected into directions perpendicular to the line A C B.

Hence, for the whole force of the steam employed, estimated in a direction perpendicular to the line A C B; we have

$$\frac{2e}{3.14159 \&c.} \times r \times 3.14159, \&c. = 2re.$$

And for the strain at A, or B, we have $2re \div 2 = re$.

And now, $(te) : re :: 1 : (th)$. Whence $re = (th) \times (te)$; and $e = \frac{(th) \times (te)}{r}$; also, $(th) = \frac{re}{te}$.

usual working pressure, or five times the usual working pressure.

And, next the force of steam, which a *low* pressure boiler, 90 inches in diameter, $\frac{1}{4}$ of an inch thick, is capable of resisting, is $= \frac{1}{4} \times \frac{30,000}{45} = 166\frac{2}{3}$lbs.; which is $156\frac{2}{3}$lbs. more than the usual working pressure; or $16\frac{2}{3}$ times the usual working pressure.

Hence, if the excesses, merely, be considered, laying aside the ratio of the elastic force of the steam in the two boilers; it appears that the *high* pressure engine is safer, by $443\frac{1}{3}$lbs. per square inch, than one of the *low* pressure kind. But, on the contrary, if the ratio of the elastic force of the steam in the two boilers be considered, and the excesses be laid aside, it will appear from the above results, that the *low* pressure engine is more than *three times* as safe as one of the *high* pressure kind; or that the safety of the *low* pressure boiler is to that of the *high* pressure boiler, in the proportion of $16\frac{2}{3}$ to 5.

But it can be shown that either engine can be made entirely safe; and that one kind is not, in *fact*, any more liable to explode than the other.

To prove this, we have (by mechanics) the thickness of a *low* pressure boiler, 90 inches in diameter, capable of resisting 10lbs per square inch, $= \frac{45 \times 10}{30,000}$, $= .105$ in.; and that of a *high* pressure boiler, 30 inches in diameter, capable of resisting 150lbs. per square inch,

$$= \frac{15 \times 150}{30,000} = .075 \text{ inches.}$$

And now, if we multiply the first of these results by 10, we shall have .15 inches for the thickness of a *low* pressure boiler, capable of resisting ten times the usual working pressure; which is 90lbs. above the usual working pressure.

And the thickness of a *high* pressure boiler, capable of resisting ten times the usual working pressure, is

$$= \frac{15 \times 150 \times 10}{30{,}000} = .75 \text{ in.}$$

; and, lastly, the thickness of a *high* pressure boiler, capable of resisting 90lbs. per square inch above the usual working pressure, is

$$= \frac{15 \times 150 + 90}{30{,}000} = .12 \text{ in.}$$

Hence, as it is fully practicable to make a boiler of a thickness equal to any of the foregoing results, it is plain that one kind of engine may be made just as safe as the other.

I shall merely add, that, as the tenacity of metals is diminished by an increase of temperature, the tenacity in the case of the *high* pressure boiler should have been taken something less than in the case of the *low* pressure boiler.*

On the subject of the injury which each engine is capable of producing, in case an explosion takes place, the committee are amply prepared to decide.

I am, sir, yours respectfully,

To Professor Silliman. A. B. Quinry.

LXXXIII.—*Further Observations on the different Modes practised in Husbanding Flax in Ireland. By Mr.* William Salisbury.

DEAR SIR, *Brompton, Nov.* 16, 1825.

I have to lament that I did not see the proof of my letter, contained in your last number of the *Technical*

* As no experiments, have ever, to my knowledge, been made for determining the decrease of the tenacity of metals, corresponding with a given increase of temperature; and as this in my estimation, is a subject of considerable philosophical interest, I will respectfully suggest to the gentlemen who compose the present committee, that they have such experiments instituted, as may, if possible, detect the *law* by which the tenacity *decreases* during a given *increase* of temperature.

Repository, page 276, as otherwise two inaccuracies, which have escaped correction, might have been avoided. In page 277, line 2 from the top of the page, the word "forest" should have been "perfect;" and in page 279, line 25, for "thousand," read "hundred."

I have received a letter from Ireland since its publication, requesting that I would more particularly describe the causes that lead to the immediate advantages which the new British method of treating flax has over those in common use. To this I am desirous of making the following reply, and also of affording some statements and facts in illustration thereof.

And, first, the descending sap vessels in the bark of the flax-plant, from the leaves to the root, and which constitute the fibres, being of different lengths, according to the leaf to which each of them is attached, are found, when the fibres in an individual plant are completely separated, to be from one inch to twenty, and more, in length; and if a person were to take hold of the middle of the congregated fibres, he would find that the number of them between his grasp and the root end would be much greater than of those towards the upper end of the plant. Now, when the steeping process is performed, and the plants are dried, the whole being crushed between coarsely grooved rollers, which break the woody parts, the flax or fibre is thereby loosened; the flax is then taken hold of by the root ends of it, and laid over the sharp edges of the tables of the scutchers, when their swords or arms flying swiftly round, beat off what wood may remain adhering to the fibre, leaving the flax (if it be sound) remaining in the hand of the person thus employed; and provided the flax could be all scutched alike, little or no waste would thus be made: but we must consider, that only the uppermost end of it is yet cleaned; the workman turns it, and submits the other end to the same operative power; here, however, he finds a great diminution; all those fibres that were attached to the leaves of the lower half of the stem

are beaten off by this rude instrument, and doomed to mingle with the wood and refuse, and thus become irretrievably lost, or at most only serve as fuel, to dry and crisp the succeeding portions of flax, and which are condemned to the same destructive manipulations.

Hence (except in saving the seed, as it is lately professed to be in the muddy system of steeping) there is no return, either in fodder for cattle, or in manure to the soil; and, under such a system, it is no wonder that flax should be considered as an exhausting crop: this has long operated to the prevention of its more general culture. Were, however, the farmers, from any similarly erroneous system, induced to half rot in water all the straw of their barley, and then to reduce the remainder to ashes, would they not find that system of husbandry equally to exhaust their land? This is, notwithstanding, the *summum bonum* of flax husbandry, under the best management as at present generally practised.

In regard to the economy of machinery, and its application to the purpose in question, it is necessary to consider, that the scutch mill cleans the farmer's flax with more facility than he can do it at home; and, probably, in Lincolnshire or Kent, where agricultural labour is scarce, and on an average four times dearer than in Munster, there is good reason to employ machinery; that reason, however, does not exist where persons are pining in distress for want of employment, and who, to their credit, will work well at all times for reasonable and moderate pay. It is an easy day's work for a grown person to break, in the new method, 16lbs. of flax stem, which produces 4lbs. of fibre; if these are paid 2*d.* per pound, they will earn 8*d.* per day each. By the following contrast, it will be seen whether it be not better to pay to those persons 2*d.* per pound, or 2*s.* 8*d.* per stone, than to pay to the scutch mill 1*s.* 1*d.*, and suffer the *loss, waste, and deterioration which we daily see.* In Ireland there are no poor's rates, and the exercise of machinery, when such waste is made

as more than counterbalances the difference in manual labour, is extremely injurious to the poor: and I am sure that there are but few of the Irish resident landowners but who will agree with me in this opinion, when they consider the drift of my appeal, which is to improve and extend the linen trade, to increase the culture of land, and to give the poor an employment natural to the country and beneficial to themselves, as well as to the general welfare of the nation at large.

The return, as to the quantity of flax generally produced on an acre, is stated, by Arthur Young, Middleton, and others, as being from 30 to 45 stones, of 14 lbs. each, per acre. Vide "Annals of Agriculture," &c. &c. I shall presently quote another work, of very high authority, and show what my Irish friends get from their best crops; but first I must make the following comparison, by detailing, for the information of my correspondent, the result, in point of produce of flax, in fodder, &c. from the methods I advocate.

First, then, if the flax be dried upon the land, it tends to enrich it, from the decomposition of the foliage and the discharge of moisture from the stems.*

Secondly, the seeds altogether are saved, and the same advantage made thereby as the Dutch boast of.

Thirdly, a moderate crop of flax, when divested of the seeds, will produce two tons of flax stems, every particle of which will turn to good account.

The flax, when dry and stacked up, is taken, at the farmer's leisure, into a barn, &c., and broken by the simple means already mentioned, and the fibre, without the wasteful and expensive means of scutching, is wholly

* Some of the small farmers in Tipperary, of whom I purchased their growing crops of flax, had sown clover seed with it, and when the flax was pulled, and laid to dry on the land, it was remarked, that a most luxuriant growth of the clover took place. This was in consequence of the protection to the young plants, and of the manure afforded by the decomposition of the foliage; and it produced the finest autumnal crop of clover I ever beheld of the same age.

preserved in the hands of the operators; by which means, experiments have universally proved, that *from a given quantity of flax stem, one-fourth of its weight is afforded in fibre or flax, of the very best quality.* Hence, *ten hundred weight is the usual,* and, I may venture to say, *the average product, wherever the new mode is practised,* for I have frequently obtained 12½ cwt. of fine flax fibres per acre.

The woody part of the plant remaining after the extraction of the fibres, consisting of sugar, tannin, mucilage, &c., forms a nutritious food for cattle; and I have the authority of one of the first veterinary surgeons in the empire for stating, after a series of actual experiments made by himself in feeding horses upon it, that it was well worth half the current price of oats.

Hence the farmer obtains manure for his land, by the crop being laid to dry thereon.

Seed, part of which will serve him for a future crop, and the rest will be valuable for extracting oil.

Food for his horses* in considerable quantity; and a crop of flax fibre, not only of superior quality but in much greater abundance.

In further illustration of these facts, having already quoted the best English authorities, I shall now proceed to make extracts from the Report of the Irish Linen Board for the same year in which my experiment was made in the province of Munster, and contrast them with the results of my practice. There are stated the following accounts of experiments made to ascertain the produce of flax crops, and their relative value:---

In page 35 it is reported, that on Feb. 10th, 1823,

* The wood of the flax, when thus separated, is extremely light, and liable to be drawn up the nostrils of the animal; but if it be made a little damp that inconvenience is obviated. It is usual to mix a few oats with it, as is common with cut chaff, &c.; or if the lighter part of the seeds be steeped with it, in the proportion of one peck to two bushels of this flax wood, in a few gallons of boiling water, a jelly is formed that is very fattening for cattle.

22 bundles of flax, weighing 20 lbs. each, or 440 lbs., produced, from the scutch mills, 4 stones* and 14 lbs., or *one-fifth*† and 10 lbs.

Now, *by the new British method, one-fourth of the weight is yielded in flax fibre,* which would have been 6 stones and 8 lbs., a gain of 32 lbs. in this small quantity, and, at the price the best flax was then sold for, the following difference would have occurred:—

6 stones 8 lbs. at 8*s*.....	£2	8	0
4 stones 14 lbs. at 8*s*.....	1	12	0
Leaves.....	£0	16	0 in favour

of the new British system.

Page 109:—Nine acres of land produced 350½ stones of flax, after being scutched at a mill. Now, according to the above statement, had the new British system been practised, a saving of 24 stones would have been effected; and, at the same price, £9. 12*s*. would have been put into the grower's purse that was thus thrown away, a sum equal to the rent of the land in many places where the best flax is produced.

In the above Report, the statements I have quoted are made to show the advantages of the scutch mills; and the trials were, no doubt, made under the eyes of those who are advocates for those machines; and no doubt the experiments were fair, and the results such as would actually be the case, if flax could always be secured of the same identical quality after steeping, which, however, it never can be. I will, however, wave all considerations to the contrary, and place my own method in competition, leaving them to remain for the consideration of those who are interested in the welfare of Ireland to consider the

* In the South of Ireland 16 lbs. of flax is a stone, but in other parts only 14 lbs.

† The average of *one-fifth*, being stated as above, was taken, it will be observed, from flax after being steeped and dried, in which operations it lost a considerable portion of its weight. Had it been possible to have drawn the conclusion, with an account of such loss in weight, the proportion would have been *less* than *one-fifth*, and consequently *much less per acre.*

subject, as it affects the public in a political point of view.

Political economists inform us, that we should never suffer, if possible to avoid it, the waste of any substances that will afford food to animals. Here we find, that forty bushels of broken flax stems per acre are saved, worth 40*s.*; and that, on trial, they were worth half the current price of oats for feeding horses with.

This is nothing, however, compared with the following facts. In the usual practice of flax dressing, the sum of £16. 9*s.* 8½*d.* was paid to the owner of a wasteful scutch mill, employing probably four men for five days, as the mill I made my experiment at, prepared with that manual assistance 75 stones daily.

Thus five poor men were employed four days each, having by this husbandry obtained twenty days work, and been paid at the rate of 1*s.* per diem Irish, because they were expert at scutching, alias *wasting* the flax.

From the prices of the necessaries of life among the labouring poor of Munster, when I was there, 8*d.* per day was considered the best wages, and few got work at that rate, but all would have been a happy people, and loyal, if they had. Now, let us consider how many poor persons would have reaped advantages by the other mode, had it been practised: the same five poor men would have been maintained nearly twelve months of their usual working time. Now, then, it comes to the simple question, which is the best mode of preparation?

If we ask what causes the distress in Ireland, the answer is, want of employment for the people.

What remedy is at hand? Answer, let every person trading in flax have it manufactured in the new way, and he will soon remedy the evil, and the country would be renowned for making *good linen*, instead of a *flimsy fabric* composed of a material half rotted before it is made into cloth, and nearly destroyed by bleaching.

Were it possible to enact any ordinance, which should

cause the Irish people to pursue the plan of making *good linen*, they would have no want of employment nor of capital in the country, and neither religious feuds, absentee landlords, nor Captain Rock, would ever more be heard of.

I must postpone my further remarks on this subject till my next, and in the mean time remain,

Dear Sir, yours very truly,

To T. GILL, *Esq.* WILLIAM SALISBURY.

LXXXIV.—*Further Particulars of Mr.* JOHN CUTHBERT'S *new Reflecting, Compound, and Single Microscope.**

WE have again been gratified by Mr. Cuthbert with a farther elucidation of the various advantages of the above microscope. He first exhibited its effects as a compound microscope, which we had not witnessed before, the usual buttons with object glasses being substituted in place of the speculums; its performance was very satisfactory, and the whole field of view was equally distinct all over it. He then removed the object glasses, and substituted the speculums, and showed us its use as a reflecting microscope for opaque objects, and which also was perfectly satisfactory; but its powers as a reflecting microscope for transparent objects are most extraordinary.

It was a dull rainy day, and yet even by that imperfect light the minutest parts of the different test objects were distinctly seen.

It is, we understand, Mr. Cuthbert's intention to adopt his reflectors to the bodies of any good compound microscopes, which the proprietors of them would wish to be provided with so desirable an addition; by this means the expence will be greatly lessened to such persons, and their microscopes will undergo no change in any other respect, but be equally serviceable as before as compound microscopes.

* See page 285 of the present volume.

LXXXV.—*On Improving the Quality of Saws, by Hammer-hardening their Teeth.*

THE Editor lately mentioning to Mr. Christie, the worthy Secretary of the London Mechanics Institution, Mr. Turrell's great improvement in gravers, effected by hammer-hardening them;* it occurred to him, that the practice, frequently adopted by smiths, and other workmen, of hammering the worn and blunted tops of the teeth of their back and frame-saws, merely with a view of spreading them sideways, so as to free themselves in use, previous to filing them sharp again; must not only have that effect, but must likewise greatly conduce to the improvement of their *hardness* and *toughness*, from the *condensing effect* of the hammer upon them.

Mr. J. I. Hawkins,† on being informed of this, by the Editor, perfectly agreed in this opinion of Mr. Christie's; but, with his usual acuteness, suggested the farther improvement of first filing the teeth into shape, and then finishing them *by hammer-hardening their tops;* which would not only spread them out sideways, but would also preserve to them all the advantages of the effect of the hammer upon them; which, according to the present practice of filing them after hammering them, are in a great measure lost; and he thought there would be little difficulty in applying his improvement to the teeth of all saws, which were not exceedingly small. He would screw the saw fast in a vice, (the teeth in the chaps of which were guarded from indenting the saw, by plates of copper lining the chaps on each side,) and, with the flat cross-pane of a hammer, the handle of which was held towards the fore part of the saw, and the hammer itself at a proper angle, to suit the form of the teeth, he would then hammer-harden every individual tooth.

* See page 296 of the present volume.

† The ingenious inventor of the superior process of washing-over Emery, for nice purposes, described in vol. vii. page 45.

The best saws are those which have been considerably condensed by hammer-hardening them on their sides, in making them; but this additional process, of hammering the tops of their teeth, cannot but prove a considerable improvement upon them.

LXXXVI.—*On the great improvement made in Bricklayers' Trowels, by Hammer-hardening them.* *By* Mr. GEORGE WALBY.*

THERE is, perhaps, no implement which undergoes more severe treatment than the bricklayers trowel does, in its constant employment of hacking bricks into shape, and thus encountering the pieces of flint, pebbles, &c. ordinarily mixed with the clay; and which, besides having a tendency to injure its edges, also render it liable to break continually. Mr. Walby, therefore, by his excellent processes, accomplished a most difficult task, and rendered his superior trowels highly prized, by those persons who were the most competent judges of their merit, from their constant experience in their use; and, indeed, his brick-trowels, like the hand-saws made by the Editor's late father,† were continually changed, by grinding, into other and smaller kinds, until they became too diminutive for any useful purpose; their originally excellent quality remaining perfect to the last.

They were made of the best shear-steel, carefully worked throughout, and especially to avoid over heating the steel; and towards their finishing in the plating or forging, and when nearly reduced to their proper thickness, besides heating them in a clean hollow-fire, to avoid contact with cinders, &c., he also removed all scales upon their surface, previous to giving them their last planishing, under the rapid blows of a hammer driven by a steam-enhine, by means of a very ingenious revolving elastic steel brush of his invention.

* See a description of the glass-drop pinchers, blast-furnace, or hollow-fire, used by him in heating his trowels, in vol. vii. page 117.

† As mentioned in our Article "*Iron and Steel*," see vol. i. page 133.

He carefully attended to the proper hardening heat, and quenched them in a composition or hardening liquor, similar to those used by saw-makers: he next blazed them off to the spring temper; and, lastly, *hammer-hardened them as much as possible.* They were then ready for grinding, after which operation, their elasticity being again restored, by blueing them, they were glazed or brightened, ready to be mounted into their handles.

We have many particulars of the various tools, used by Mr. Walby in his practice of trowel-making, and which are well deserving of being published.

On the improvement of Drills, by hammer-hardening them cold.

Mr. Andrew Pritchard, the inventor of the hard shell-lac cement,* finding that steel, when hardened and tempered, is susceptible of receiving the condensing effect of the hammer; has applied it, with considerable advantage, to the points of small drills, by hammering them upon their flat surfaces.

On improving the Edges of Square Broaches, or Boring-bits, by Hammer-hardening them.

Mr. Joseph Clement, an excellent workman, and mechanical draughtsman, informed the Editor, since the publication of Mr. Turrell's great improvement in gravers, that a friend of his in Scotland, many years since, improved the quality of his square broaches, by hammer-hardening them cold, after being hardened and tempered upon their flat sides. He, however, kept this process nearly a secret.

The Editor thinks it would have been much better *to have hammered them upon their angles, as Mr. Turrell does his gravers,* which would have had a much better *condensing* effect; and then to have ground them again, to bring up the blunted edges to their proper figure for use. The five square broach is also equally susceptible of improvement in this way.

* See vol. vii. page 303.

LXXXVII.---*On the employment of Cast-Steel Plates, for Engravers, in their Carbonated state.*

WE are glad to find that cast-steel plates are now beginning to be employed by some of our first rate artists, without having undergone the process of *decarbonating* them as usual. Their advantages are eminent, not only in the greater facility of etching cast-steel than iron; but, chiefly, in the increased number of impressions they will afford.

Here Mr. Turrell's improvement on the graver is invaluable; and indeed, previous to his informing his brother artists of his method of condensing their edges, by hammer-hardening them, the difficulties they had to encounter were nearly insurmountable.

LXXXVIII.---*On the advantages of improving the qualities of Cutting Instruments, by burnishing, and thereby condensing their edges. By the* EDITOR.

WITH FIGURES.

(Continued from page 303.)

Farther particulars on Grinding, Whetting, and Burnishing the Edges of the Currier's Shaving Knife.

SINCE the publication of our remarks on the above subject, we have obtained such additional information on the manner of treating the edges of this important instrument, that we need make no apology for again bringing the subject before the notice of our readers.

The currier's shaving knife is a two edged instrument, about three and a half or four inches broad, fourteen inches long in the blade, and half an inch thick in its middle part, gradually tapering away from thence to its edges. Fig. 2, of plate xii. is a section of it, and fig. 3, a front view of it.

It will be seen from these figures, that it has two handles, one in the direction of the blade, and the other at right-angles to it. It requires to be made of excellent steel, and be well tempered; and, indeed, there are but very few makers of repute in this line, in this country.

When the edge requires grinding and whetting, in the former of these operations, viz. the grinding, is performed upon a flat rub-stone, similar to what carpenters sharpen their plane-irons on, with the application of water. This stone is about six inches broad, and eighteen long, and so very careful are they to to keep its surface flat, that it is a regulation in the work-shops, for every workman, after using the stone, to write his name upon it with a piece of coal; when, if his successor finds it left so uneven, that a halfpenny can be passed underneath the edge of an iron, straight-edged, laid upon it, the former workman is subjected to a fine for his carelessness. After being carefully ground upon this stone, it is whetted upon a flat circular piece of Welsh or Scotch blue-stone, about eight inches in diameter, likewise with the application of water, carefully preserving the edges straight and linear; but which, as it can only be done by a dexterous and constant habit, it is impossible to describe here. The edges are now ready to receive the effect of the burnisher upon them, to turn them to the two opposite sides, and fit them for use.

Of the Burnisher.—This instrument consists of a hardened and polished steel wire, having its end made hemispherical, mounted into a handle of hard wood, both being exactly of the form and size of fig 4. This delicate instrument is ordinarily held by the small part of its handle, between the third and little fingers of the workman's right-hand, ready for use at each cutting-stroke or shave made upon the wet leather by the knife, to renew its edge; first, by raising it, by passing the hemispherical end of the burnisher along it; and then, to turn over and give it its proper direction for use, with the cylindrical part of it likewise passed lightly along it. This delicate operation must be seen, however, to be perfectly understood; our section, fig. 2, will afford some idea of it.

The manner of holding the knife in use, will be seen from fig. 5; which also is a representation of the currier's shaving-beam, and its frame or support, A B C D, the basis of the frame; E and F, upright pieces, which sup-

port the cross-piece G, upon which the middle of the beam H rests, whilst its lower end is either lodged against the cross-piece or any of the intermediate cross-bars I I I, &c. according to the angle to the K, given to it, represents the wet leather, lying upon the beam; the workman stands with it placed before him, and sloping from him, and holds the knife L, in the position shewn.

The beam requiring to be of hard wood, only where it is worked upon; it is not necessary for the whole of it to be formed of such, as shewn, in the figure; but merely to have a piece about two feet long, affixed upon the upper end of the beam. The flat upper surface of this part is very carefully finished by the currier himself, by scraping it with his shaving-knife. Query, may not this practice, have been borrowed from the currier by the cabinet-maker, in his steel-shave?

On improving the edges of Penknives by Burnishing them.

The Editor, following his old habit, of reasoning from analogy, thought, that, as the advantages of burnishing the edges of currier's shaving-knives, cabinet-maker's steel-scrapers, and the turning tools for brass, were so manifest, in giving additional strength, toughness, and smoothness to their edges; so the application of it to the edge of a penknife, might likewise prove advantageous; and, accordingly, having first carefully whetted the blade of his penknife, (which is one of the ordinary quality,) upon a Water of Ayr stone, with water; he finished it by a gentle and delicate stroke of the cylindrical part of the currier's burnisher, carried along its edge, so as to throw it forward a little from the back, or convex side of it, towards the concave side; and which he found to have effected a great improvement indeed in its cutting qualities; it now seizing the quill, as it were, in making or mending a pen, and making a smooth polished cut, such as he was never able to effect by it, previous to this application of the burnisher; and the edge has endured in use for a considerable time,

in mending a number of the portable pens, laid by for that purpose; so that he can safely recommend it, as a considerable improvement, on the edge of that useful and necessary instrument, the pen-knife.

On Burnishing the Edges of Turning-tools for Brass.

On the Editor mentioning to Mr. Cuthbert, the late Mr. Fiddler's practice, of burnishing the edges of his turning tools for brass;* he assured him that it was likewise his constant practice; and shewed him an *oval* burnisher, which he kept entirely for that use.

LXXXIX.---*On the Employment of the Anthracite, or Stone Coal, as Fuel, in the United States;† and suggestions for its use in this Country.*

It appears, from the report of the Lehigh Coal and Navigation Company, in the National Gazette of Jan. 20, 1825, that "the new coal mine, on the north side of the mountain, presents a bed of coal, one hundred feet thick." "The quantity of coal on the land of the company, is supposed to be equal to a four equal-sided prism, of five hundred feet on each side, and seven miles in length; the largest body of coal known."

Professor Silliman remarks "there can be no doubt, that this coal will become an object of vast national importance. It is a very pure anthracite, but sufficiently combustible, *in a proper apparatus*, and *with proper treatment*, to maintain a constant, and (if desired) intense fire, which burns without odour or smoke---is perfectly safe, although left for the night; and, without watching, will continue till the morning, and will then be found in a state of sufficient activity. It is admirable for halls, churches, or other similar places, where it is desired to throw into circulation a large volume of warm air; and we have it on the best

* See page 432, of the present volume.

† From vol. ix. of the American Journal of Science, &c.

authority, that it is excellent for the smith's forge, and for other purposes.

Thus far Professor Silliman; and we have it besides, from other sources, that a newly invented steam-boat, in the United States, is also intended to consume the anthracite as fuel.

There seems some mystery, however, in the manner of employing it; as it is stated, that it will require "*a proper apparatus, and proper treatment.*" Now, from analogy, we should presume, that the mode which has succeeded so perfectly with Mr. Evans, *in causing gas-coke, a fuel equally as devoid of bitumen as the anthracite itself is, to burn with such energy,* in the fire-place of his high pressure steam-engine;* namely, by the introduction of the waste-steam, under the bars of his grate, must prove equally efficacious in the case of arcthracite; at any rate, it well deserves a trial; and, should it be found to succeed, it will prove the fortunate means of bringing the immense beds of anthracite in this country, particularly in South Wales, into request. A boiler to generate steam, may easily be contrived to be heated by the apparatus.

There is, however, no difficulty whatever in employing the anthracite as fuel in furnaces, when mixed with a small proportion of bituminous coal, as is frequently done in this country, and with a considerable reduction of the smoke ordinarily produced; indeed that trifling quantity may be destroyed, merely by permitting a small supply of fresh air to pass around the register-plate or damper, which is ordinarily interposed between the boiler or furnace and the chimney-stack; and which, affording a supply of oxygen to the heated smoke, kindles it into flame in the chimney. This may easily be done, by making the groove in the brickwork through which the damper slides, too wide for it; and the quantity of air may, if thought necessary, be also regulated, by admitting it through a register.

* See page 94 of the present volume.

Mr. Jacob Perkins informed the Editor, that there is no difficulty in using the Anthracite as fuel. He is in the practice of employing gas-coke in his furnaces, taking the precaution of having water always lying in the bottoms of his ash-pits, and which, either from the hot cinders continually falling into it, or from the heat passing through the bars of the grates, is continually evaporating, and affording steam to the fire.

XC.—*On the Utility of the Spanish Chesnut-tree.* By Lewis Majendie, *Esq.**

SIR, *Hedingham Castle, Essex, Oct. 31, 1799.*

In the course of last winter I planted a field, in the parish of Castle Hedingham, containing somewhat less than four acres, with seven thousand two hundred and four Spanish chesnut, and one thousand nine hundred and eighty-seven ash trees. It was my original intention to have composed this plantation totally of chesnut; but not having a sufficient number of that plant, I filled up the remaining ground with ash.

Concerning the latter plant, I shall not trouble you with any mention, because the unusual and very extensive scale on which the culture of the ash has been adopted by Mr. David Day, of Rochester, who has so deservedly been the object of the society's honours, must render any thing I may say on that subject superfluous.

The culture of the Spanish chesnut-tree has, for some years past, been the object of my particular attention, and though, as yet, the time has been too short to allow me to speak from decided experience, yet such has been my success in cultivating this tree, as to satisfy me of its general utility.

The oak, the pride and glory of the forest, must, from

* From vol. 9, of the Trasnactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

its many excellent qualities, ever maintain the pre-eminence it so justly merits; the chesnut, however, can boast of some qualities, even of the higher order, hardly inferior to the oak, and in the more subordinate line of utility, it may be said even to surpass it; I mean, in its various uses for underwood.

It is much to be lamented, that, in the formation of underwoods, so little attention seems to have been had to the sort of tree requisite for such purposes: instead of the Spanish chesnut or ash, it is too common to see large tracts of wood-land whose underwoods consist chiefly of hazel, hornbeam, and others of little use but for fuel; whereas the first-mentioned trees, besides being equally serviceable for that purpose with the latter, are greatly superior to them, as well as to most others in essential uses: so that, at the same time that the refuse of their growths might be consigned to the fire, the better parts might be destined to those purposes for which they are more particularly suited; and by such management a double advantage would arise.

Amidst a variety of subordinate uses to which, from my own observation, the Spanish chesnut seems adapted, are those of poles for hops, and stakes for various purposes of husbandry. I have formed several plantations of this tree, with the view of treating it as underwood. The tree itself possesses a peculiar faculty of brancing, provincially called *stubbing*, from the roots after being cut down, and this in a much greater degree than any of the useful forest-trees; so strong indeed is its propensity that way, that it is with some difficulty and attention that timber-trees of the chesnut are restrained from this redundancy of growth, which it is apprehended, by preventing part of the nutrition from ascending the stem, is apt to hinder their progress: but this quality, however inconvenient it may be in its effects to trees intended for the purposes of timber, is of eminent advantage to those designed for underwood: since, when the tree, after standing two or perhaps three years, to enable it to form a sufficient root, is cut down to a proper

distance from the ground, it throws up in the following summer a profusion of straight shoots, which in due time become poles, such as for strength and durability exceed all others whatsoever, even those from the ash, which is generally considered as the best tree for this purpose.

Chesnut poles, it must be confessed, are slower in growth than those from the ash; but, on account of their greater durability, they are more profitable to the possessor; and I have been credibly informed, that in some parts of Kent, where this useful tree has been adapted to this purpose, its superiority to the ash is uncontroverted.

For the purposes of stakes for hedges, or other uses of that nature, its superiority seems equally established. I some time since formed a hedge, the stakes of which are wholly from chesnut-trees of my own planting; they are of such a degree of hardness as to satisfy me that the character given of its use for such purposes is by no means unfounded.*

The plantations of this tree which I have formed, excepting that above mentioned, are mostly cut down for underwood: the luxuriancy and quantity of shoots from the stubs afford me great satisfaction, and will, without doubt, answer my highest expectation.

As it has been with so much earnestness recommended by writers of eminence, as well as by the truly excellent and laudable society to which you, sir, are attached, to revive the lost culture of the Spanish chesnut, I can but feel an ardent wish, from a conviction of its real use, to second such views, by doing all that is in my power to attract the attention of persons of more experience and penetration than myself to the culture of a plant, which in this part of the country might almost be deemed an exotic.

I have the honour to remain, sir,

your most obedient humble servant,

To Sam. More, *Esq. Sec.* LEWIS MAJENDIE.

* Poles of this tree for hops, vines, &c. will last longer than of any other, and stakes of the underwood will last nearly twice as long as those of any other sort.—Vide *Hunter's Evelyn's Silva*, ed. 2, vol. I. p. 154.

XCI.—*Notice of the Formation of the Franklin Institute in Philadelphia.*

A SOCIETY has been established in the city of Philadelphia in the course of the last year, under the name of the "*Franklin Institute* of the State of Pensylvania for the Promotion of the Mechanic Arts." "The object of this Institute is the promotion and encouragement of manufactures and the mechanic and useful arts, by the establishment of popular lectures on the sciences connected with them; by the formation of a cabinet of models and minerals, and a library; by offering premiums on all objects deemed worthy of encouragement; by examining all new inventions submitted to them, and by such other means as they may judge expedient."

The members of the Institute are to consist of manufacturers, mechanics, artisans, and persons friendly to the mechanic arts; and stated meetings are to be held quarterly.

The officers for the year 1825 are—James Ronaldson, President; Mathew Carey, Isaiah Lukens, Vice-Presidents; William Strickland, Recording Secretary; Peter A. Browne, Corresponding Secretary; Thomas Fletcher, Treasurer, and twenty-four Managers.

A regular system of lectures has been given during the last winter by the three professors already appointed; viz. Robert M. Patterson, M. D. Professor of Natural Philosophy; William H. Keating, Professor of Mineralogy and Chemistry; and William Strickland, Professor of Architecture.

A professorship of *Mechanics* also is created, but this chair is not yet filled. Besides the regular lectures, volunteer and occasional lectures have frequently been given, on various subjects, by several members of the Institute.

An *Exhibition* of the products of domestic industry was held, pursuant to the plan adopted by the Board of Managers, on the 18th, 19th, and 20th of October, 1824,

during which time a great number of articles were exhibited, a detail of which is given in the First Annual Report* of the Institute. Annexed to this Report are proposals for a second Annual Exhibition, to be held in the 6th, 7th, and 8th of October, 1828, to which all persons are invited to send the products of their skill, ingenuity, and industry. The proposals for this Exhibition, with the list of premiums offered, occupy eleven pages, which we would earnestly recommend to the perusal of those engaged in manufactures, and who feel an interest in the cause of the arts.

XCII. *Extracts from letters addressed to Professor* SILLIMAN, *by* WILLIAM MACLURE, *Esq. President of the American Geological Society.**

Cupidity of Mineral Dealers.

THE conduct of many European mineral merchants is in a high degree scandalous and disgraceful. Some of them falsify the locality, exaggerate the scarcity, and enhance the value of all the minerals within their reach, and for the purpose of obtaining a greater price for what they have collected, actually destroy, with the rage of meretricious cupidity, thousands of specimens at the locality where they were in abundance, concealing and so disguising the place from whence they came, as to render it difficult for those that follow to procure any more. Such proceedings, hostile alike to science and to common honesty, tend to prolong the reign of ignorance and misery, and to stop the progress of the civilization of mankind, and are ten thousand times more criminal than the conduct of the Dutch spice merchants, who burned a few cargoes of spices to enhance the value of what remained, as they only pinched our artificial appetites in their indulgence in articles which perhaps did us more harm than good; whereas the destroyer of what is already

* From Vol. IX. of the American Journal of Science and Arts.

Improvements in Education—Infant Schools—Mechanical Institutions—Cheap Publications—Mr. Pestalozzi—Mr. Owen, &c.

London, 10th Sept. 1824.

I have been much gratified with the progress of civilization, in all those parts of the British dominions which I have lately visited, and anticipate much pleasure in finding still greater improvements, both moral and physical, with you; for there were only two things worth our imitating, viz. Infant Schools, Mechanical Institutions for teaching the young men and apprentices the application of the sciences to the useful arts, and their cheap periodical publications for the industrious productive classes. These are sold at from 1*d.* to 3*d.* per number, of one sheet of letter press, and they issue from the press every week in editions of 100,000 at a time, with more common sense and useful information, than would have been found circulating fifty years ago in the most highly cultivated and scientific societies. Infant schools are an excellent improvement, and a great benefit to society, and that even although they do not here learn them any thing suitable to their years, or the utility of which can possibly be understood by the children; but the congregating of them together in schools of 200 or 300, learns observers how

much can be done with children, and at how early an age they are capable of being taught most of the useful arts and sciences; and the advantages will be infinite, when ancient prejudices can be so far removed as to teach them all they are capable of learning by instruments and designs, calculated to bring many of even the difficult problems in mathematics within the reach of their comprehension. It will be an immense saving of the most valuable gift of nature—time, and tend greatly to the advancement of civilisation. I go in a few days to Paris, where I intend to sell my house, as Mr. Phiquepal goes to Philadelphia, with all his pupils as professors, to teach the system he has been perfecting these five years. Thence I go to the south, perhaps to Sicily in the winter, and in the spring to the United States. Mr. Robert Owen, of New Lanark, has just decided to make the United States the field of his future experiments, on the facility, utility, satisfaction, self-approbation, and pleasure of rendering the great mass of industrious and productive classes prudent, happy, and wise. He has purchased all the lands upon the Wabash, belonging to the Harmonists, with all the improvements, and goes there to arrange his plans of procuring the greatest sum of happiness to the greatest number. His liberal, philanthropic intentions cannot fail to interest all true friends of humanity, who must join in sincere good wishes for his success.

I have sent the last volume of the Wernerian Society, and shall likewise send any of the transactions of the Geological Society that may have been published since you got the last.

I remain, yours sincerely,

WM. MACLURE.

Professor Silliman, Yale College, New-Haven.

Basalt—Natural History Society at Belfast—Progress of Improvement in the British European Domains.

DEAR SIR, *Belfast, 18th July, 1824.*

I wrote you from Dublin, by the Dublin packet, and promised to send the Geological Society a pillar of articulated basalt, from the Giant's Causeway, but was prevented by a prohibition by two of the parties and a bishop, who pretended to have claims to the soil, and who would not permit a rock to be taken from it, or any depredation, as they termed it, to be committed. I now send you a small box of specimens, though imperfect, from the constant rain during my stay at the Causeway. They may serve as a comparison with others, although I do not perceive any great difference from other basaltic regions which I have seen, except the articulations of the pillars, which are peculiar to the Giant's Causeway. The same arrangement, in ridges long and narrow in proportion to their length, the porous rock always on the summit of the ridge, and the compact basalt always at the bottom. Where they come in contact with any combustible, such as coals, these are charred from three to four feet from the junction, &c. &c. &c. Through all this country the basalt generally covers a stratum of white limestone, filled with flints, with much the same petrified shells as are to be found in the chalk.

I have left the box, W. M. No. 21, with Mr. James M'Adam, a very active member of a society lately established here for Natural History, and supported by a number of industrious young men, who will forward it to New York, care of Col. Gibbs. If you consider it useful to the Geological Society to have one of the pillars of articulated basalt, or any other mineral this country can afford, by your forwarding them a few duplicate specimens, desiring them to make a return of what you require, I have no doubt but an exchange mutually beneficial might be established, as it is a society in a state of progressive improvement, which promises much; and being composed

of young men, unincumbered with the prejudices of age, more may be expected from them than from old societies confined within the limits of etiquette and formality.

I am highly gratified with the progress of civilization in this country, more particularly in this place, in which the improvement has been, and still continues to be, rapid, and which resembles more a town in the United States for new streets and houses, than any place I have seen in Europe. The attention of many of the most liberal and influential men to the education of the millions of the productive class, is more than I expected to find anywhere in aristocratic Europe. The improvement of old, and the establishing of new schools, shows a public spirit well directed, that ought to be imitated by no country more than our own. Where the general mass rules, the diffusion of knowledge is positively necessary for the prosperity of social order, and the foundation of general happiness. Lancasterian schools are spreading fast over the whole country, and improving by the grafting of a great many of the practical rules of the Pestalozzian system, introducing by little and little to a more direct and shorter road to useful knowledge than has as yet been taken by the old systems, making utility the scale by which to measure the value of all things.

I remain, yours sincerely,

WM. MACLURE.

Professor Silliman, Yale College, Connecticut.

Mr. Phiquepal and the Pestalozzian System.

Paris, November 9, 1824.

Mr. Phiquepal sailed from Havre a few days ago for New York, in the ship Cadmus, Capt. Allyn, and carried with him about fifty packages of prints, instruments, books, &c. &c. necessary to the most easy and rapid development of the faculties, and giving correct ideas to children in the improved Pestalozzian system, without fatiguing their attention or burthening their memories, a little sketch

of which I gave you in some of my former letters; and Mr. Phiquepal has a short epitome of the method which I drew up for some of my European friends, which he intends to take off lithographically, as all the boys understand that excellent medium of communicating ideas, and work the press with ease and accuracy. Britain, beginning at last to open her eyes to her real interests, and the great advantage of a good rational education, has adopted, in many of her schools, a great part of the system of Pestalozzi, and new schools are forming every day entirely on the method; so that our colonial prejudices, which made us look up to her for precedents in morals, religion, and politics, and which as yet have been one of the greatest bars to the progress of our civilization, will now, as far as education is in question, be aided by our imitative propensity;—this, joined to the great change in public opinion with us, and the progress already made, with the brilliancy of some of the specimens already exhibited, warrants the expectation, that education, trusting to the weight and influence of its own merits, will be enabled to walk alone, when, in future, all artificial aid in direction will tend more to retard than advance its natural improvement. I have long thought of the superabundant verbiage of books, and the fatiguing task of readers, to turn over 1,000 pages in search of the lines of common sense that might be contained in a few pages, when all that is useless, mysterious, or incomprehensible, was abstracted. I am convinced that, notwithstanding my period of life, I can *begin* such a manufactory, thoroughly persuaded that the geometrical progression of improvement and civilization will support and continue it: it is a distillation to extract the essence of all books, printing them in the most economical manner, and in such forms and bulk as to suit the pecuniary powers of the poorest, which I calculate might easily be done at an hundredth part of the present prices, and with the contemplated improvements of the steam engine, and making paper with straw by a short and easy process, as is now in embryo in this country, may per-

haps be reduced to a thousandth part of the present expense.

Mr. ———, himself a brilliant specimen of the success of the Pestalozzian system, is now here. The discovery of the glucine in the cymophane, and of fluoric acid in the condrodite, after it had escaped the notice of the first European analysts, astonishes the scientific world on this side of the Atlantic; and it is the nature of the system to put the pupils on the direct road to every species of knowledge, strewing it with flowers, and creating new pleasures at every step.

LIST OF PATENTS FOR NEW INVENTIONS,

Which have passed the Great Seal since Oct. 28, 1825.

To Thomas Steele, of Magdalen College, Cambridge, Esq.; for certain improvements in the construction of Diving Bells, or Apparatus for Diving under Water. Dated October 28, 1825. —To be specified in six months.

To John and Samuel Seaward, of the Canal Iron Works, in the parish of Saint Ann, Poplar, in the county of Middlesex, engineers and co-partners; for a method or methods of propelling Boats, Craft, and all kinds of vessels, on canals, rivers, and other shallow waters. Dated Nov. 2, 1825.—In six months.

To William Ramfard, of Kingston, in the county of Surrey, tallow-chandler; for a Circumvolution Brush and Hander. Dated Nov. 2, 1825.—In two months.

To Vernon Brown, of Manchester, in the county palatine of Lancaster, silk-manufacturer and throwster; for certain improvements in the Machinery for Cleaning and Spinning of Silk. Dated Nov. 1, 1825.—In two months.

To John Isaac Hawkins, of Chase Cottage, Pancras Vale, in the county of Middlesex, civil engineer; for improvements on certain Implements, Machines, or Apparatus, used in the manufacturing and preserving of Books, whether bound or unbound. Dated Nov. 1, 1825.—In six months.

To John Ridgway and William Ridgway, both of Cauldon-place, in the Staffordshire Potteries, manufacturers of china, stone, and earthenware; for an improved Cock, Tap, or Valve,

for drawing off Liquors. Dated Nov. 1, 1825.—In two months.

To Thomas Seaton, of Bermondsey, in the county of Surrey, shipwright; for certain improvements on Wheeled Carriages. Dated Nov. 5, 1825.—In six months.

To George Hunter, of the city of Edinburgh, late clothier; for a new improvement in the construction, use, and application of Wheels. Dated Nov. 7, 1825.—In six months.

To Thomas Shaw Brandreth, of Liverpool, in the county of Lancaster, esq. Barrister at Law; for his improved mode of constructing Wheel Carriages. Dated Nov. 8, 1825.—In six months.

To Samuel Brown, of Eagle Lodge, Old Brompton, in the county of Middlesex, gentleman; for certain improvements in machinery for making or manufacturing casks or other vessels. Dated Nov. 1, 1825.—In six months.

To William Erskine Cochrane, of Regent-street, in the county of Middlesex; for an improvement in certain cooking apparatus. Dated Nov. 8, 1825.—In six months.

To John William Hiort, chief engineer in our Office of Works and Public Buildings, Whitehall, architect and surveyor; for an improved chimney or flue, for domestic and other purposes. Dated Nov. 8, 1825.—In two months.

To Charles Louis Giroud, of Lyons, in the kingdom of France, at present residing at No. 13, Queen-street, Soho, in the county of Middlesex; for a chemical substitute for Gall Nuts, in all the different branches of the arts or manufactures in which gall nuts have been accustomed to be, or may hereafter be used. Dated Nov. 8, 1825.—In two months.

To James Wilks, of Rochdale, in the county palatine of Lancaster, tin-plate worker; and John Erwyd, of the same place, grocer and tallow-chandler; for an engine for cutting Nails, Sprigs, and Sparables, on an improved system. Dated Nov. 8, 1825.—In six months.

To John James Alexander Mac Carthy, of Pall-mall Place, in the parish of Saint James, in the city of Westminster; for an improved Pavement, Pitching, or Covering for Streets, Roads, Ways, and Places. Dated Nov. 10, 1825.—In six months.

To Benjamin Cook, of Birmingham, in the county of Warwick, brass-founder; for a new method of rendering Ships' Cables and Anchors more secure, and less liable to strain and injury while

the vessel lies at anchor. Dated Nov. 10, 1825.—In six months.

To Benjamin Cook, of Birmingham, in the county of Warwick, brass-founder; for certain improvements in the Binding of Books and Portfolios, of various descriptions. Dated Nov. 10, 1825.—In six months.

To Johann George Deyerlein, of Mercer-street, in the parish of Saint Martin in the Fields, and county of Middlesex, smith and tool-maker; who, in consequence of a communication made to him by a certain foreigner, residing abroad, is in possession of certain improvements on weighing machines, which machines he denominates German Weigh-bridges. Dated Nov. 10, 1825. —In six months.

To Samuel Parker, of Argyll-street, Saint James's, in the county of Middlesex, bronze and iron-founder; and William Francis Hamilton, of Nelson-street, Long-lane, in the county of Surrey, engineer; for a certain Alloy or Alloys of Metals. Dated Nov. 12.—In six months.

To Edward Bowring, of Goldsmith-street, in the city of London, silk-manufacturer; and Robert Stamp, of Buxted, in the county of Sussex, weaver; for certain improvements in the working, weaving, or preparing silk, and other fibrous materials, used in making hats, bonnets, shawls, and other articles. Dated Nov. 17, 1826.—In six months.

To James Guestier, of Fenchurch-buildings, in the city of London, esquire; who, in consequence of a communication made to him by a certain foreigner residing abroad, is in possession of a mode or modes of making paper from certain substances, which are thereby applicable to that purpose. Dated Nov. 17, 1825. —In six months.

To Alexander Lamb, of Princes-street, Bank, in the city of London, gentleman; and William Suttill, of Old Brompton, in the county of Middlesex, flax-spinner; for certain improvements in machinery in preparing, drawing, roving, and spinning Flax, Hemp, and Waste Silk. Dated Nov. 17, 1825.—In six months.

To George Borradaile, of Barge-yard, Bucklersbury, in the city of London, merchant and furrier; who, in consequence of a communication made to him by a person residing in foreign parts, is in possession of an improved method of making or setting up of Hats, or Hat Bodies. Dated Nov. 17, 1825.—In six months.

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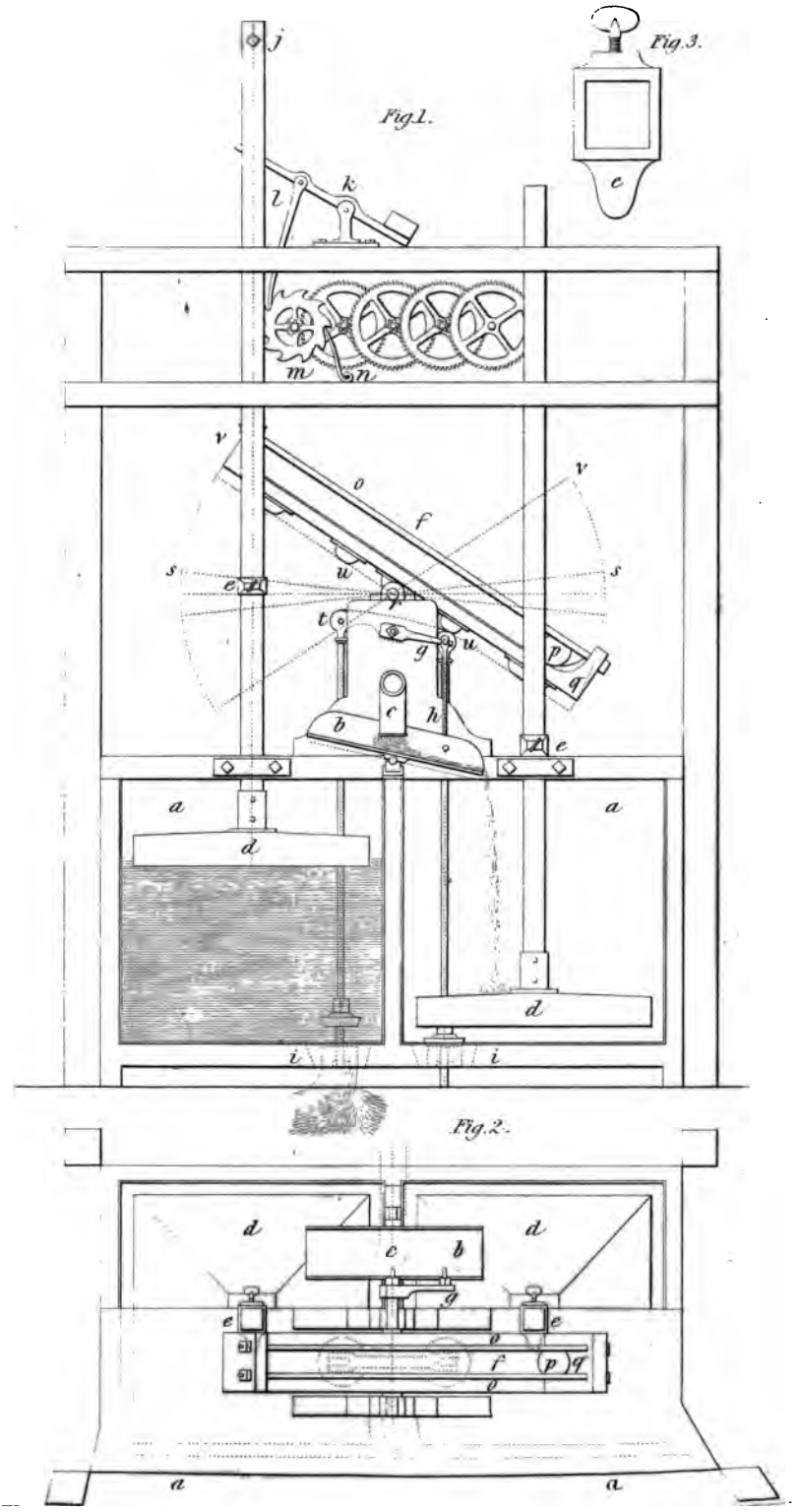
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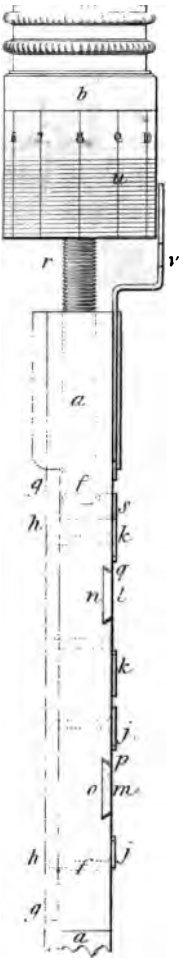

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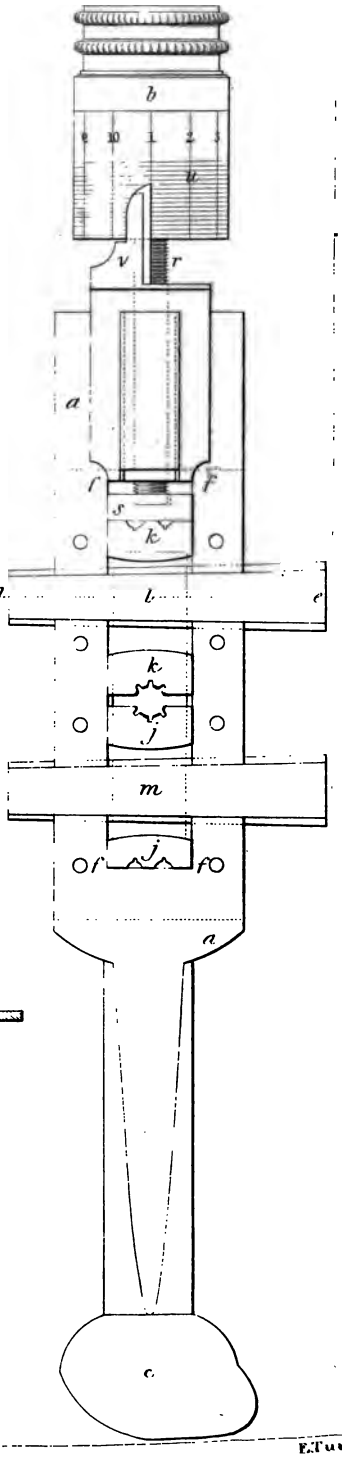

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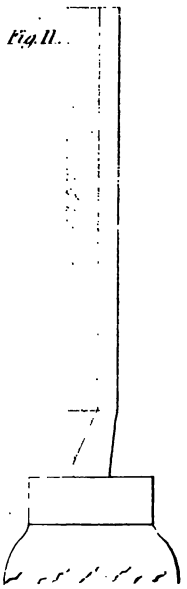

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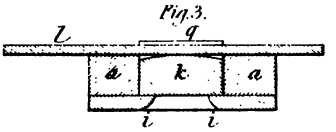

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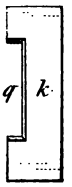

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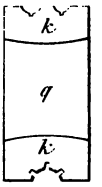

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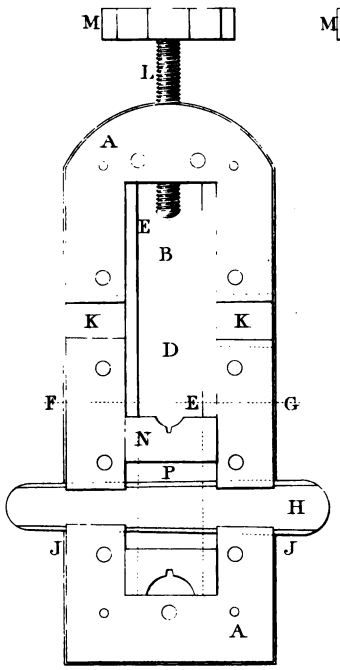

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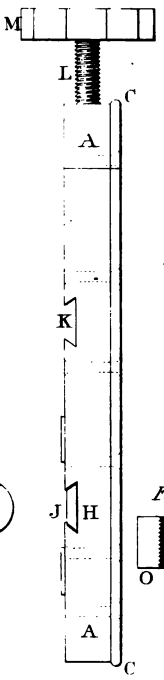

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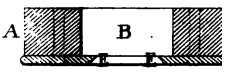

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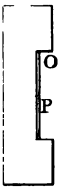

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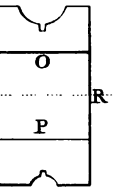

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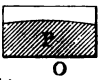

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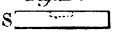

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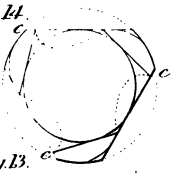

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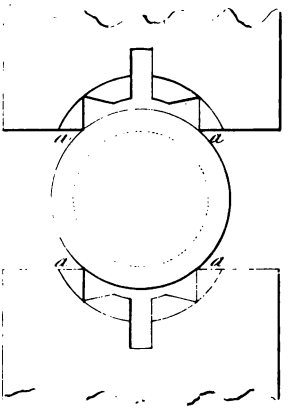

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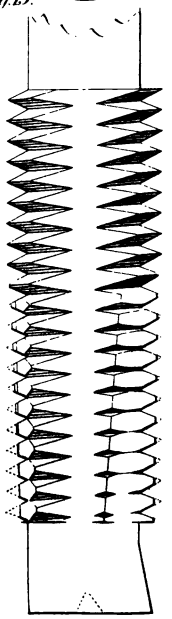

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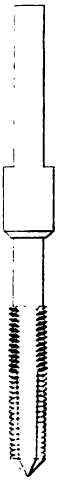

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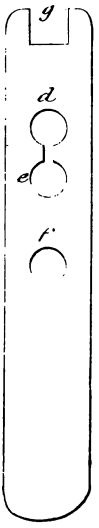

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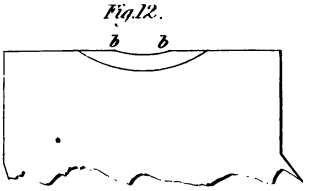

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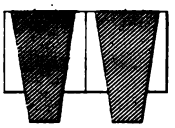

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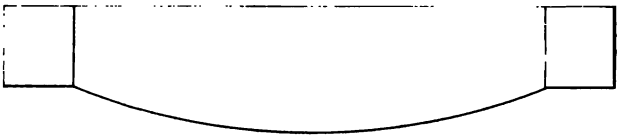

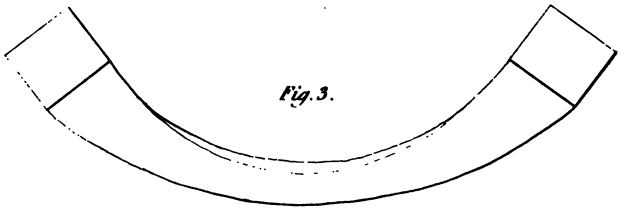

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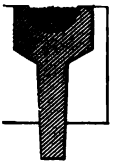

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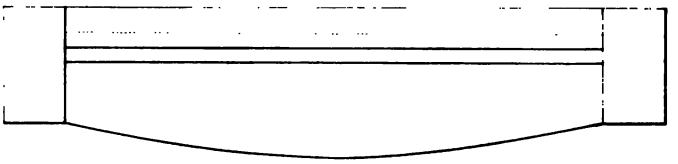

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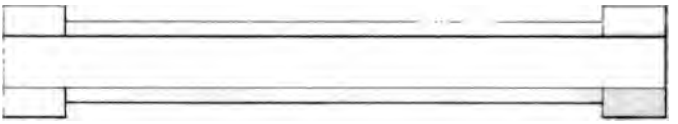

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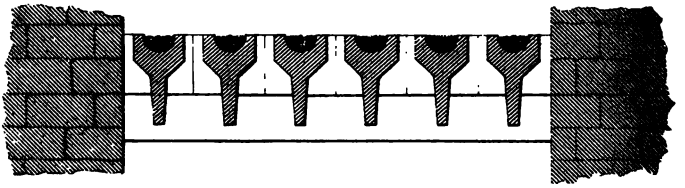

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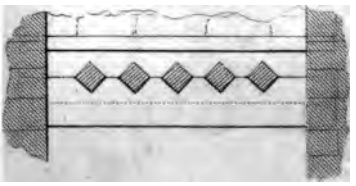

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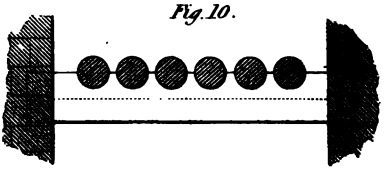

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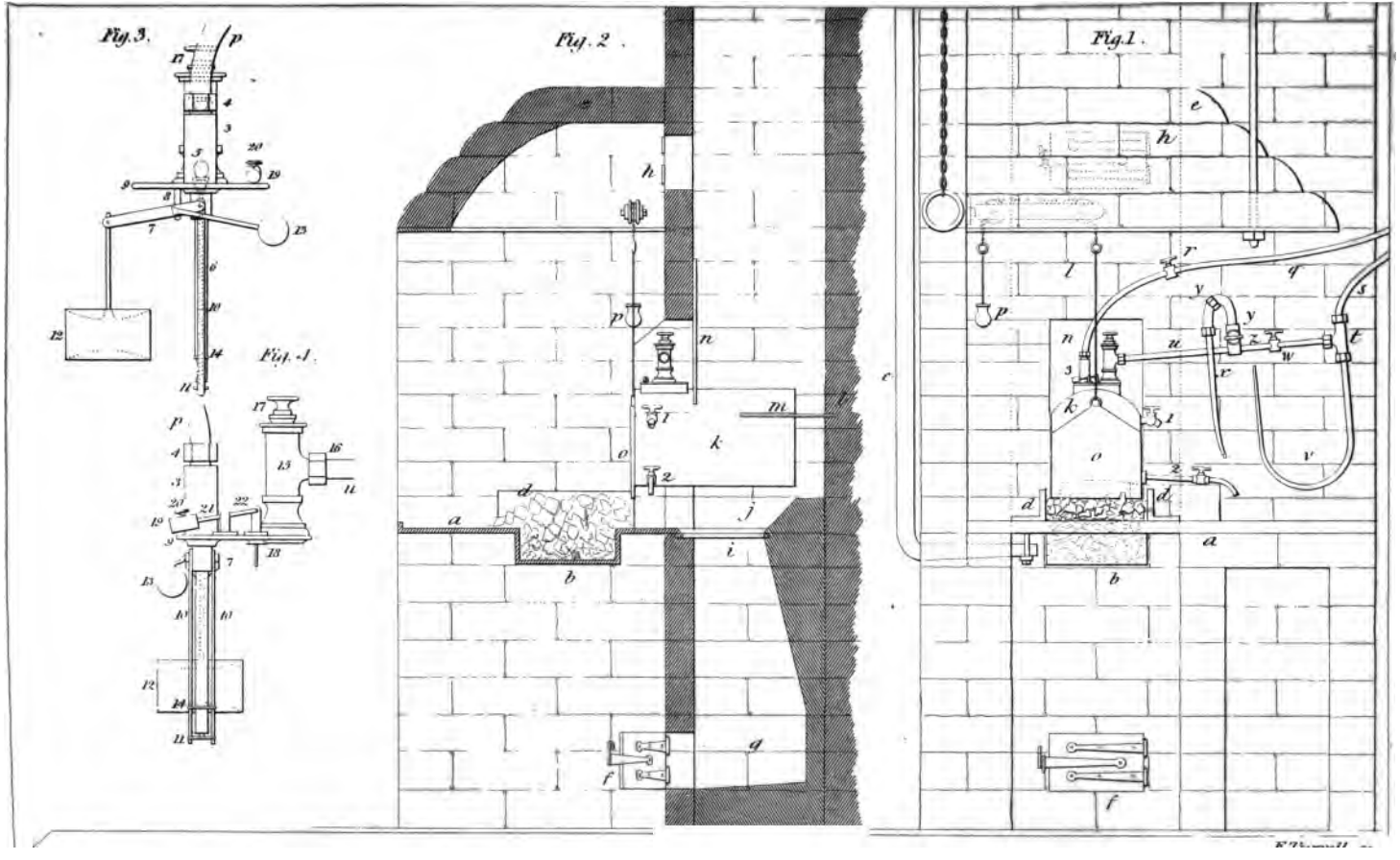
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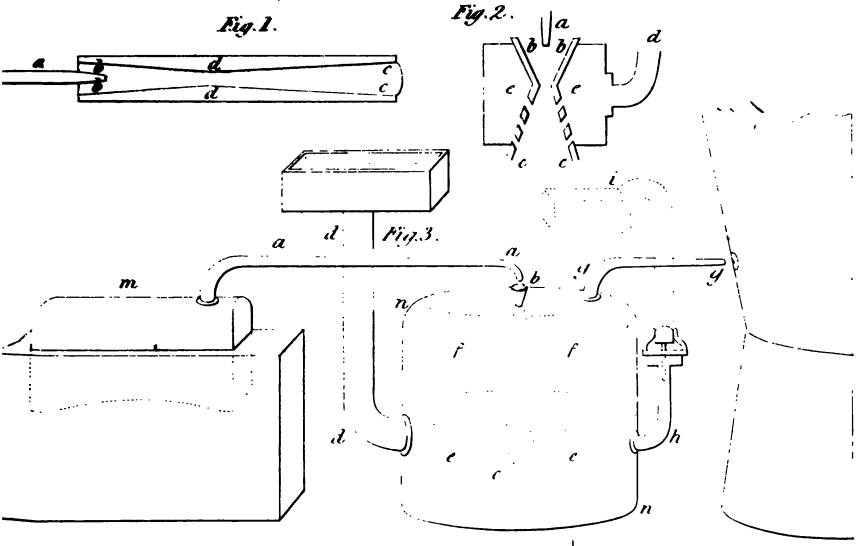
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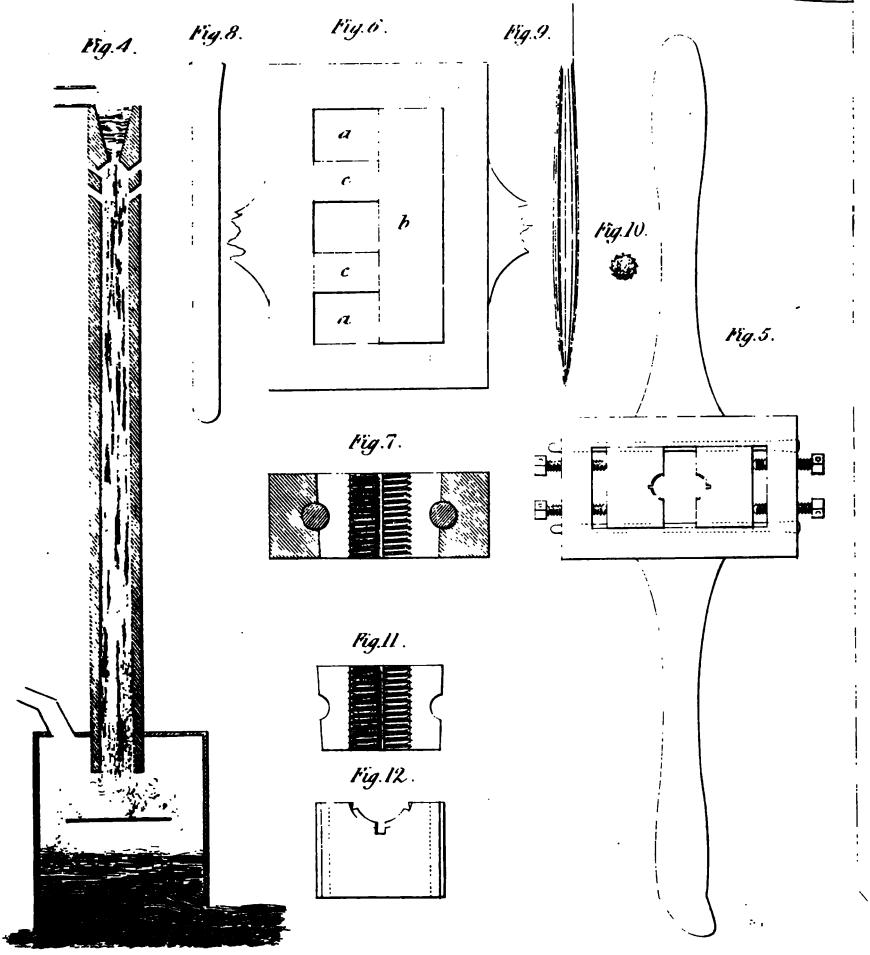
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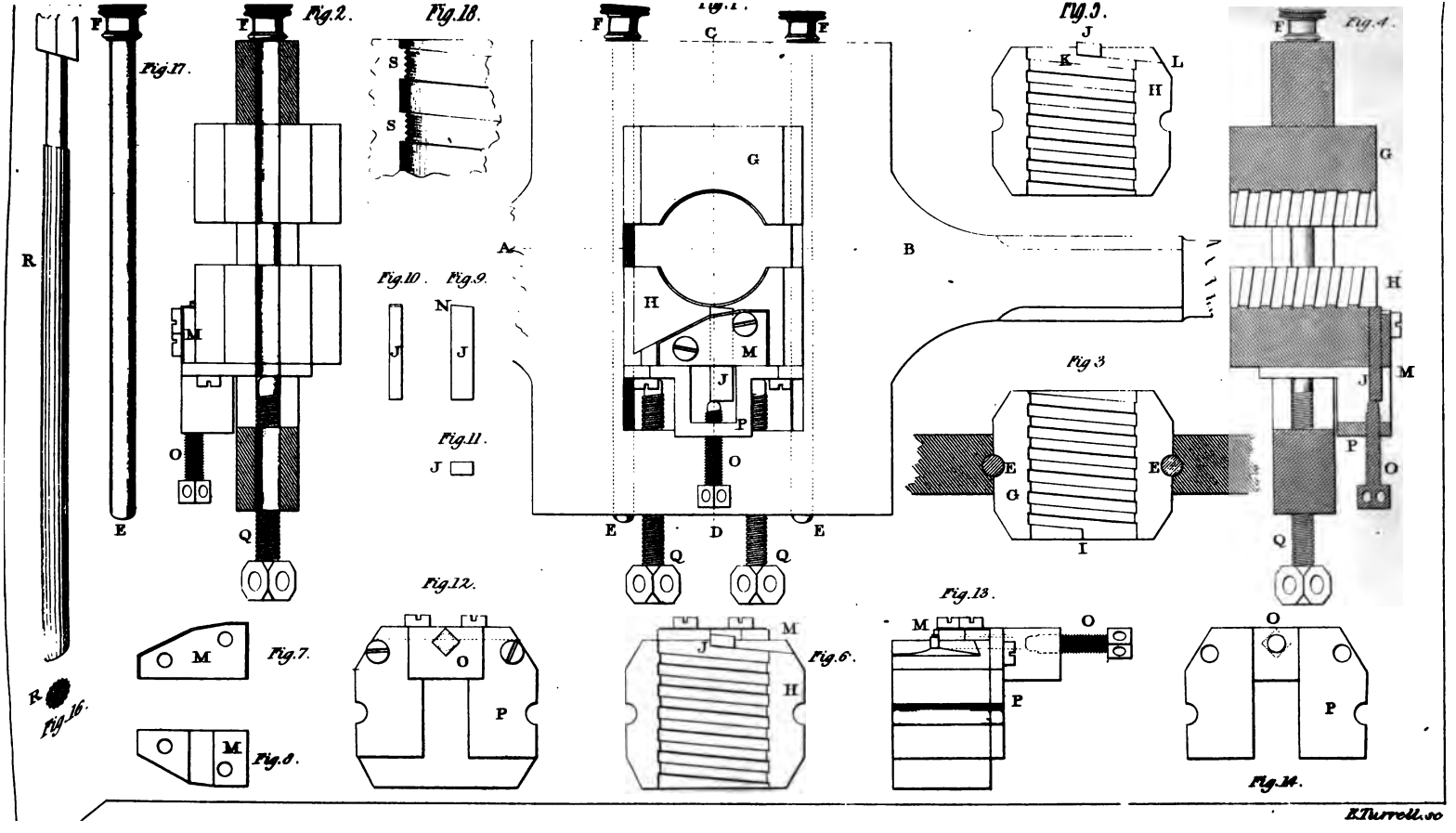
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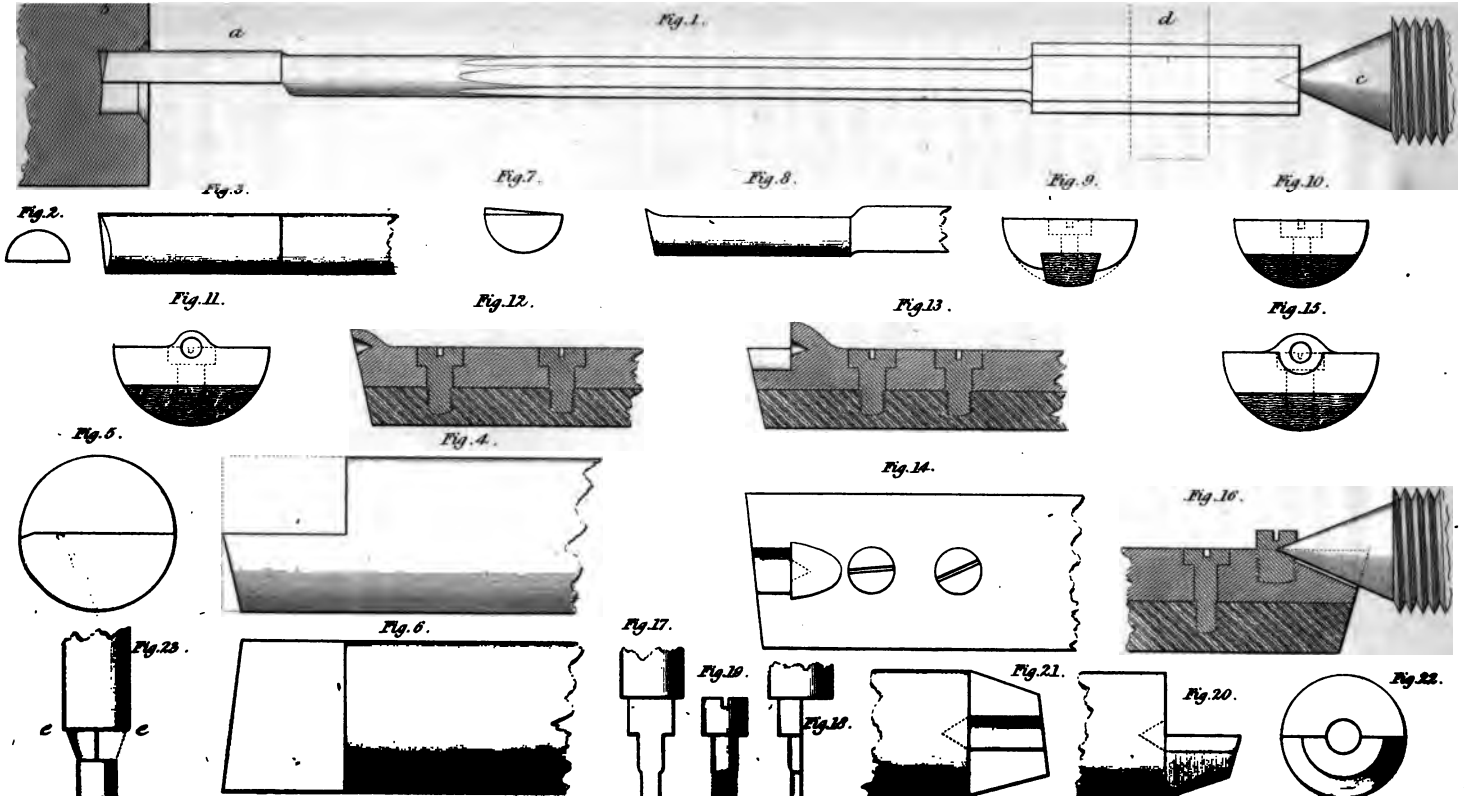
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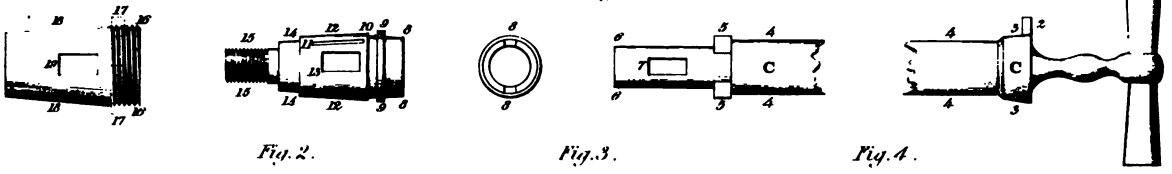

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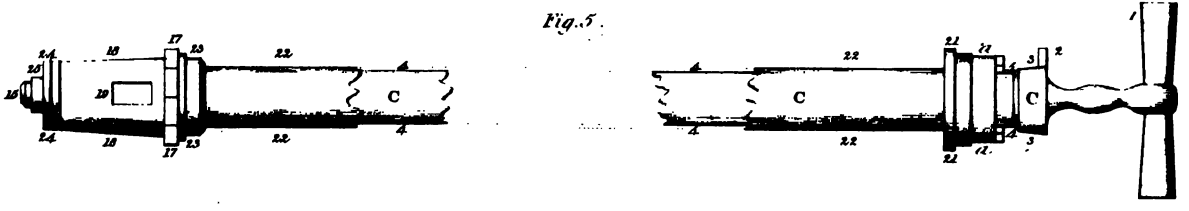

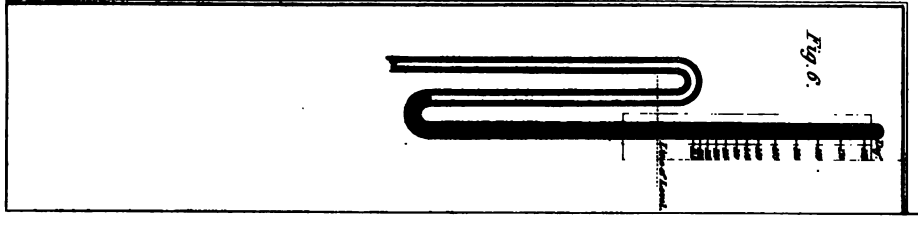

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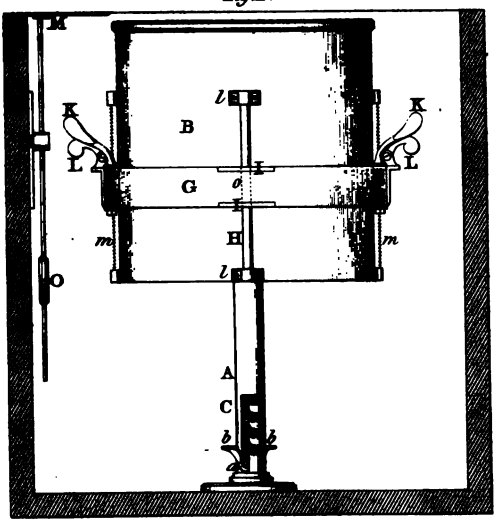

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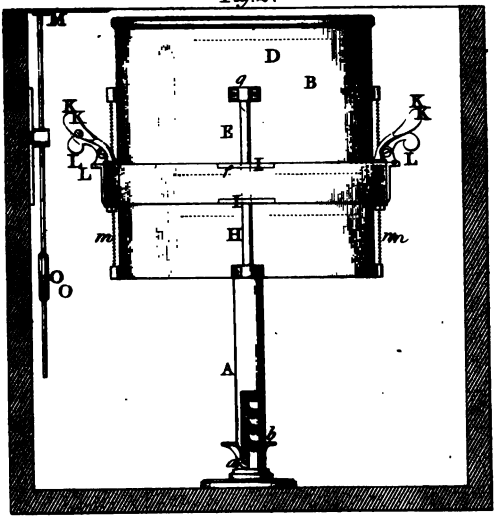

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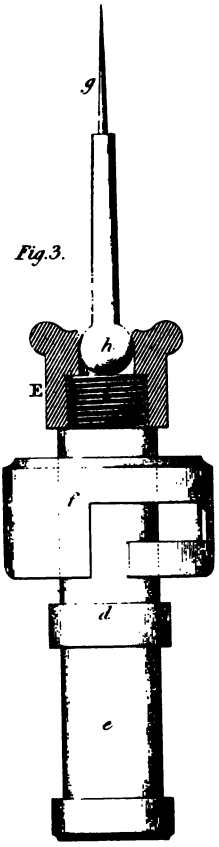

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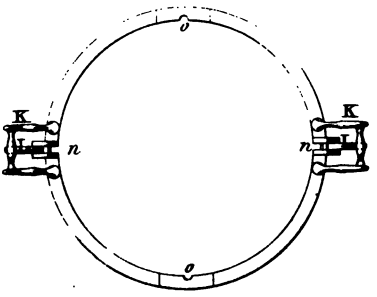

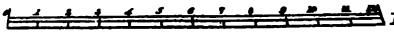

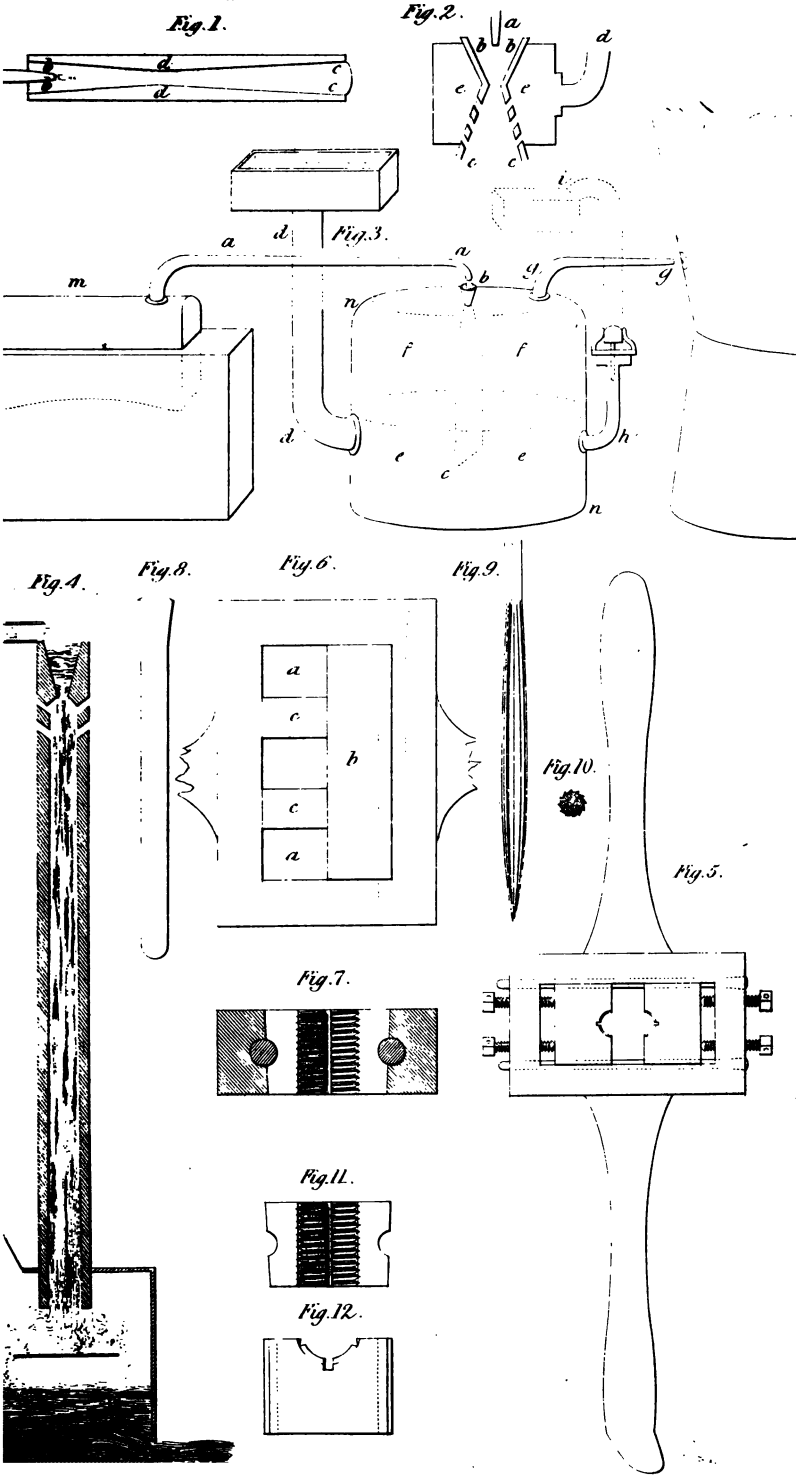
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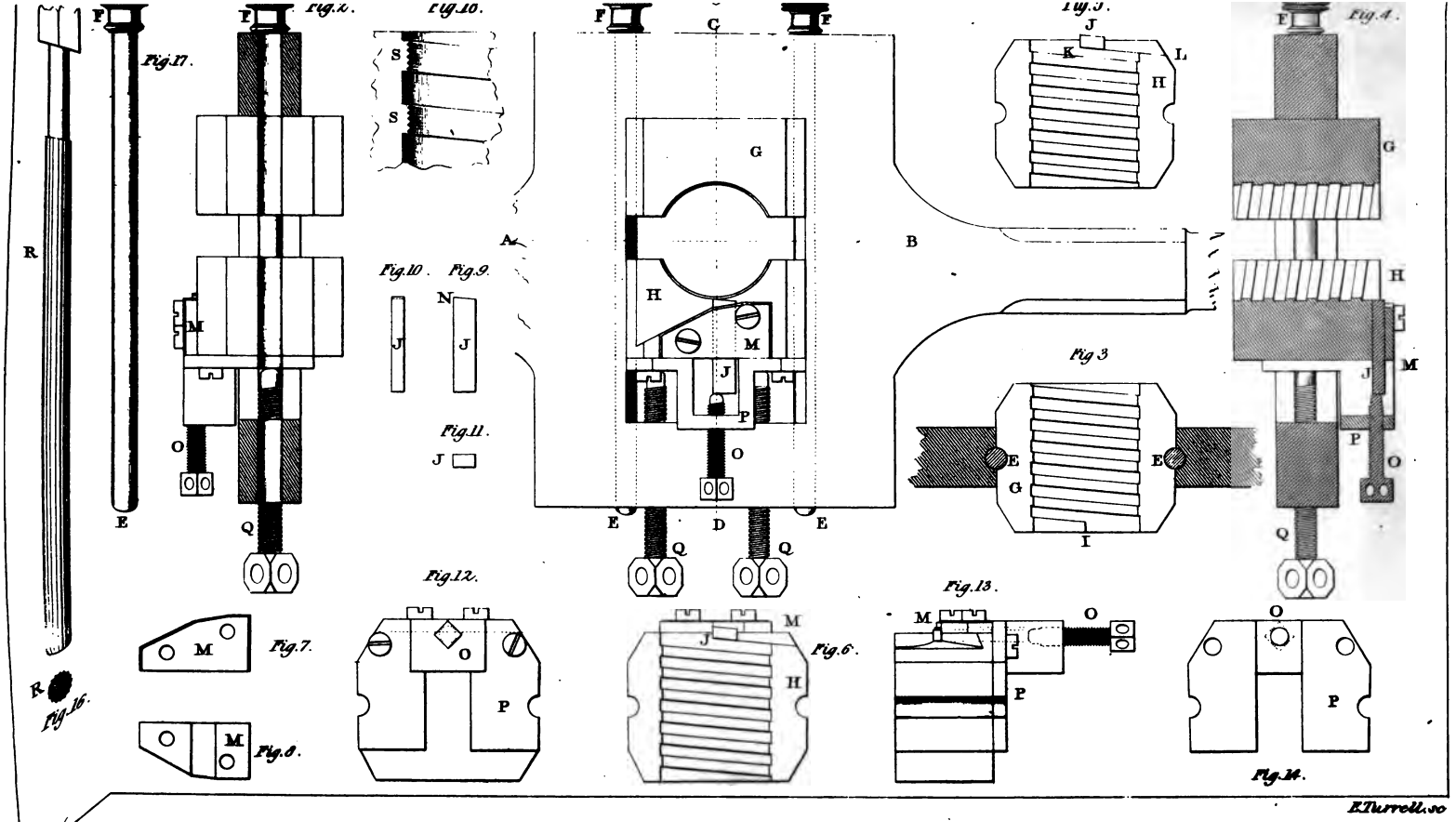
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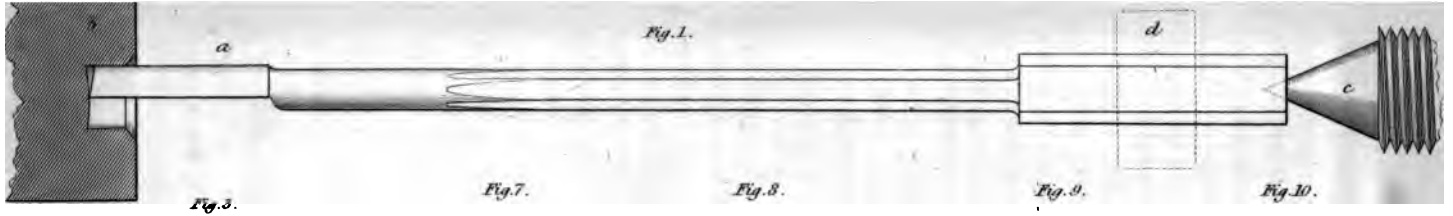

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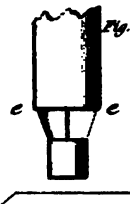

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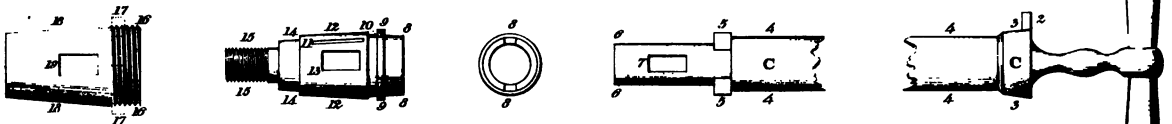

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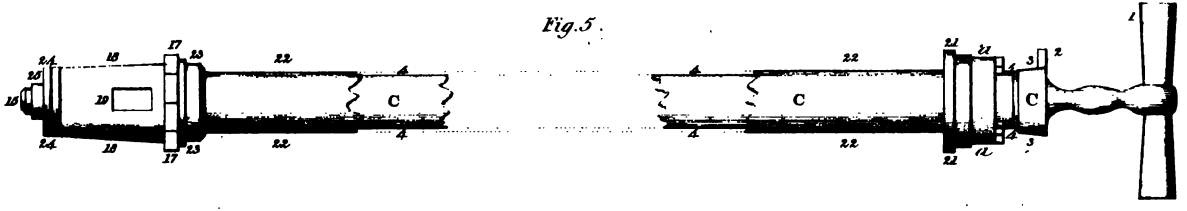

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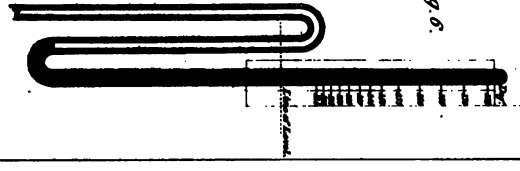

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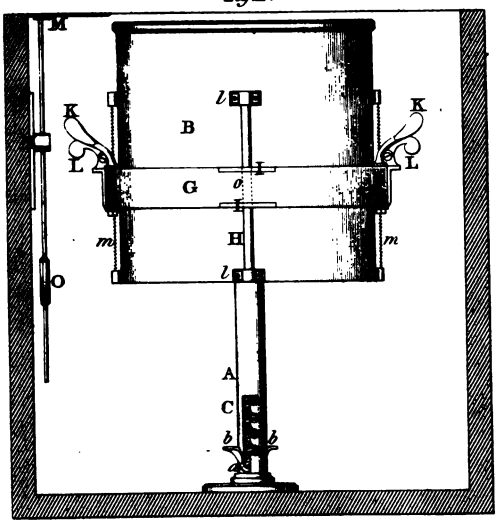

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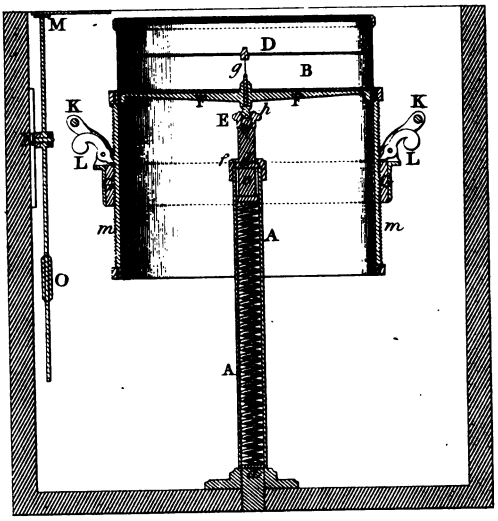

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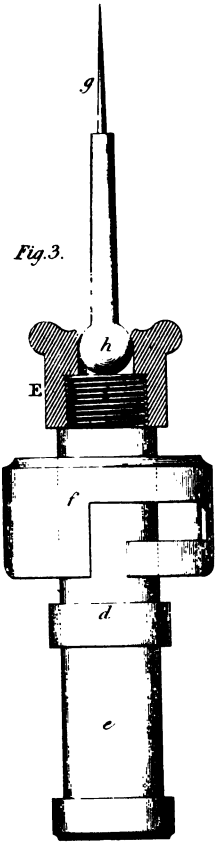

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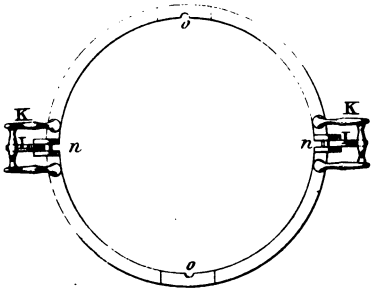

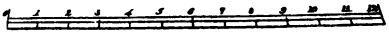

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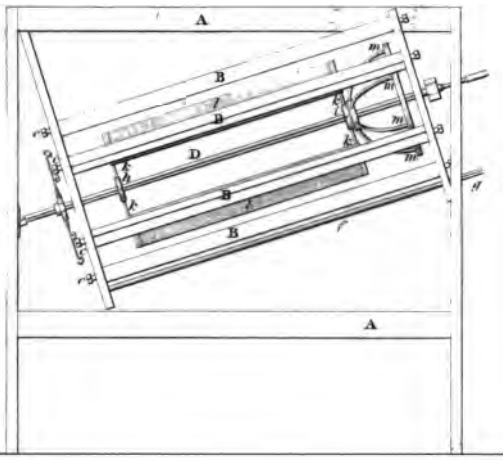

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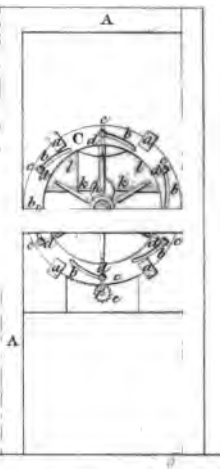

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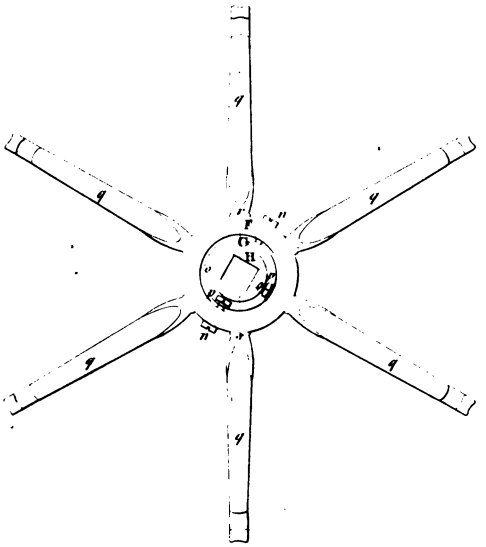

Fig. 4.

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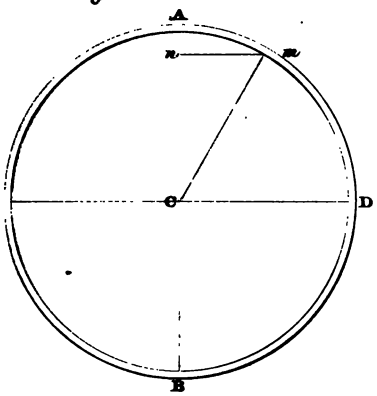

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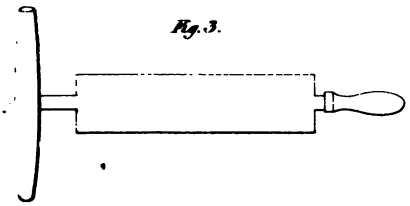
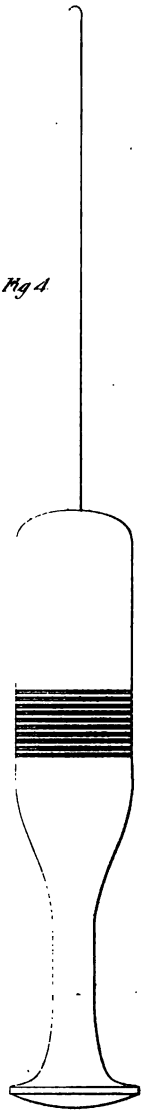
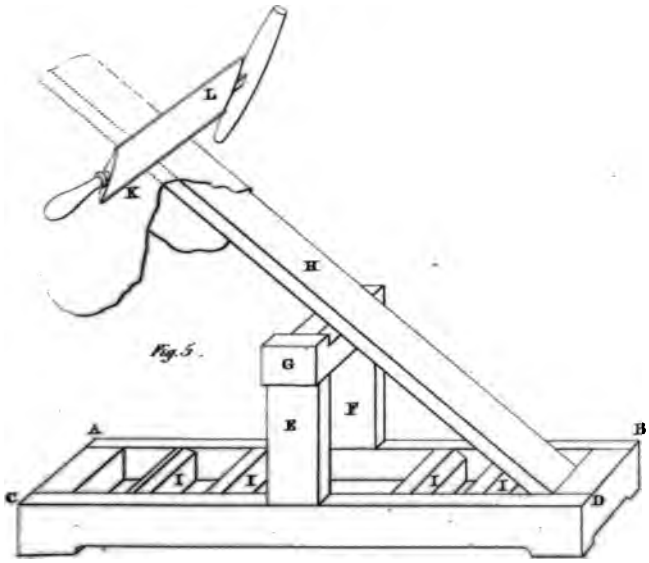
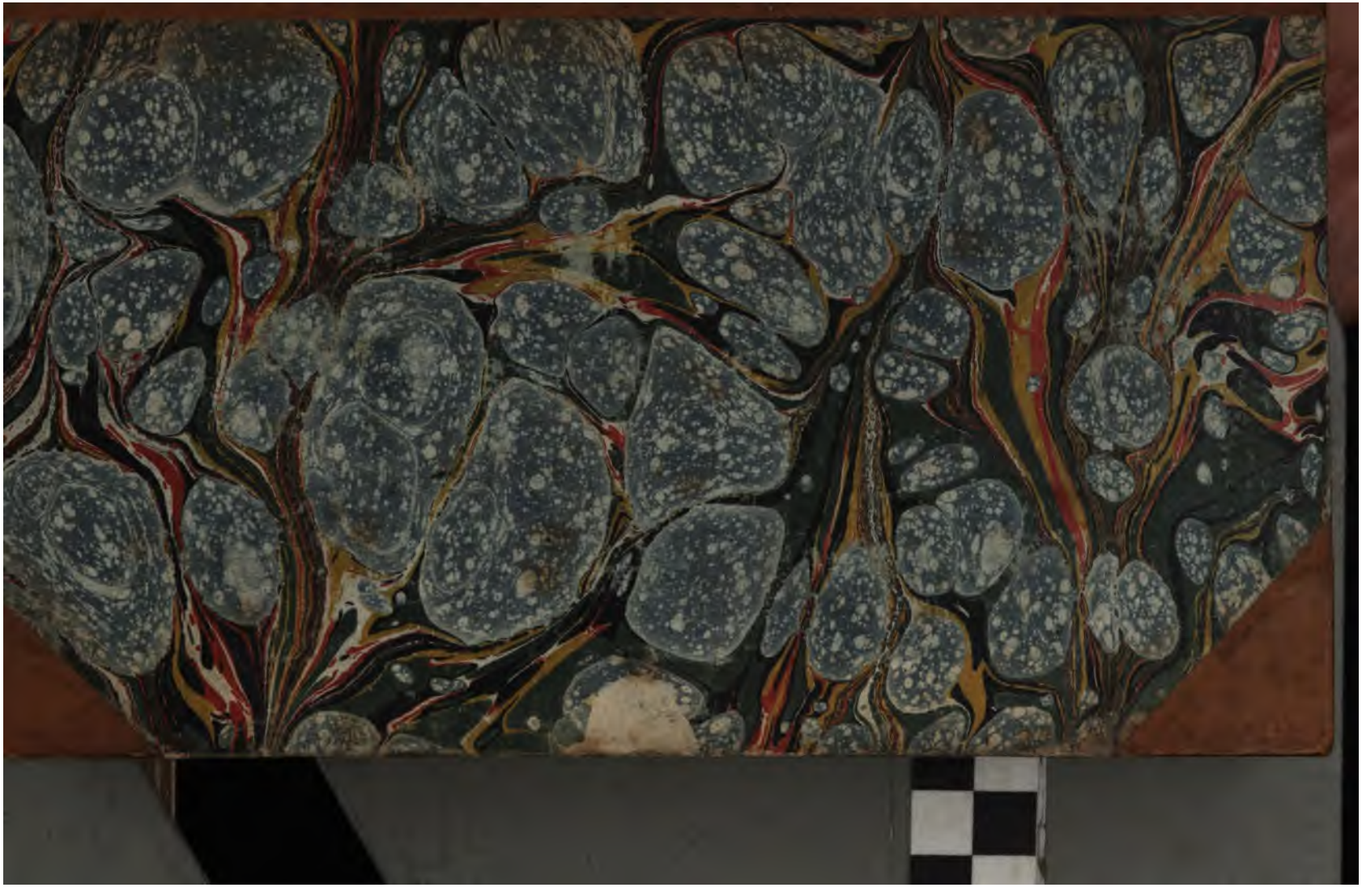


Fig 4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